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CIAL PUBLICATION
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AMERICAN DYESTUFF REPORTER

Research Reports Number

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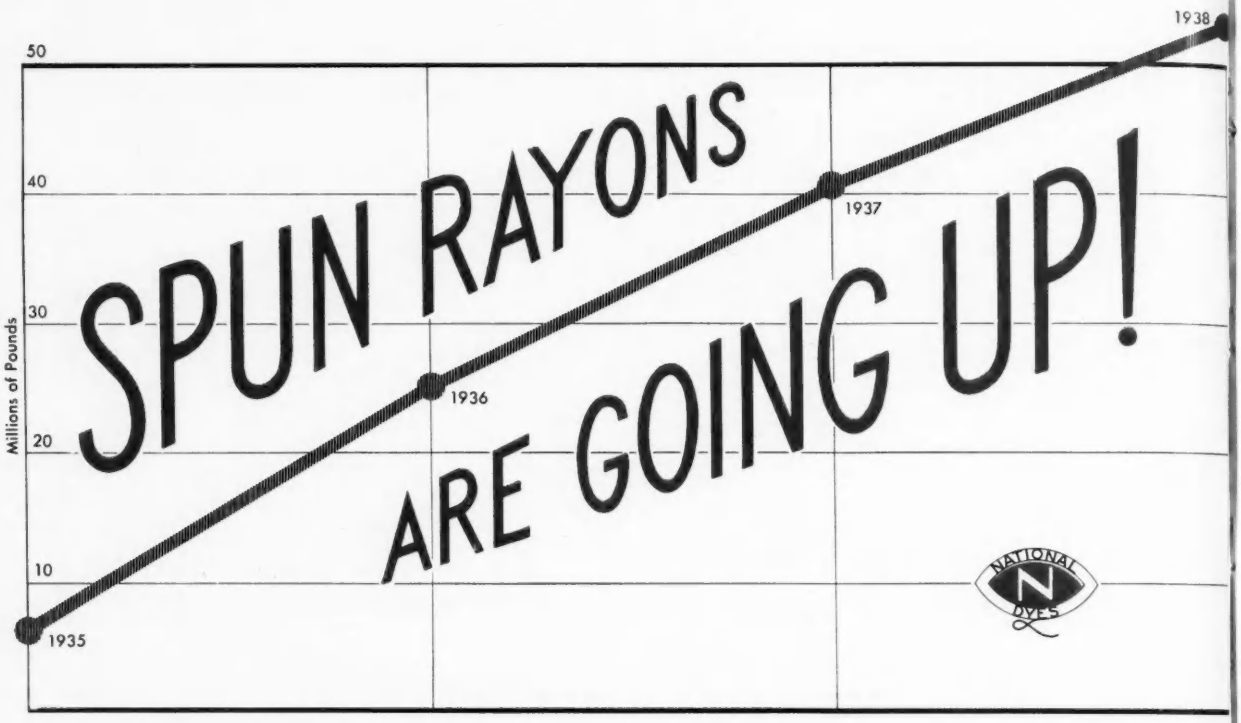

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Report of the Rayon Crepe Research

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CALENDAR OF COMING EVENTS

Meeting, South Central Section, Hotel Farragut, Knoxville, Tenn., May 6, 1939.

* * *

Meeting, Mid-West Section, Schroeder Hotel, Milwaukee, Wis., May 6, 1939. Speaker: Dr. William Stericker, Philadelphia Quartz Co. Subject: "Use of Silicates in Textile Processing."

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., May 19, 1939.

* * *

Meeting, Southeastern Section, Atlanta, Ga., May 20, 1939.

* * *

Outing, Piedmont Section, Ocean Forest Hotel, Myrtle Beach, S. C., June 23 and 24, 1939.

Report of the

Rayon Crepe Research

V. The Determination of the Effects of Variations in the Manufacture of Rayon Crepe Dress Fabrics

INTRODUCTION

THE objective of this part of the Rayon Crepe Research was to determine the effects of variations and relative importance of different variations in the individual operations in the manufacture of rayon crepe dress fabrics.

SUMMARY

In connection with the summary and details of each group it should be borne in mind that the variations in each factor studied were carried substantially above and below good commercial practice. The purpose of this was to determine the variations necessary to produce noticeable changes in the pebble of the finished fabric.

The following conclusions were drawn from the results of the investigation of the effects of variations in each individual operation:

The Rayon Crepe Research was conducted jointly by the Throwsters Research Institute, Inc. and the A.A.T.C.C. The financing of the program was made possible through a grant from the Textile Foundation to the A.A.T.C.C. and this grant was matched by contributions raised by the Throwsters Research Institute, Inc. from the industry and generous donations from their own treasury. W. F. Macia was the Research Fellow.

Parts I, II and III appeared in the November 1, 1937, Quarterly Research Number. Part IV appeared in the January 10, 1938 Number, Part VI in the April 3, 1939 Number and Part V is presented herein.

The work in each part of this program is so closely related that the reader is cautioned against drawing conclusions wholly on the basis of the results of the individual parts. The Rayon Crepe Research Commitee will correlate all of the data and publish their conclusions in the final issue.

Group A—Variations in the Total Quantity of Ingredients in the Filling Soaking Bath

When the total quantities of the ingredients used in the filling soaking bath were varied the pebble of the finished fabric was changed. The differences in pebble resulting from varying the quantity of ingredients in the filling soaking bath were not extreme but they showed that by increasing the quantity of ingredients the pebble decreased in elevation and when the quantity of ingredients was decreased the pebble increased in elevation. Refer to Plate A for photographs of the fabric made in this group.

Group B—Variations in the Jelly Strength of the Gelatin Used in the Filling Soaking Bath

The pebble of the finished fabric was affected very little by variations in the jelly strength and viscosity of the gelatin used in the filling soaking bath. Refer to Plate B for photographs of the fabric made in this group.

Group C—Variations in the Ratio of Gelatin to Dextrine in the Filling Soaking Bath

The ratio of gelatin to dextrine in the filling soaking bath had a major influence upon the pebble of the finished fabric. The use of only dextrine as a filling size caused the pebble of the finished fabric to increase tremendously in elevation and become irregular in appearance. Such a formula is never used in commercial practice. Upon the substitution of 25 per cent of gelatin for dextrine the pebble was substantially decreased and became more regular and uniform and upon substituting more gelatin for dextrine the pebble was proportionately decreased. Refer to Plate C for photographs of the fabrics made in this group.

Group D—Variations in the Quantity of Oil Used in the Filling Soaking Bath

The pebble of the finished fabric was appreciably influenced by the amount of oil used in the filling soaking bath.

Upon increasing the quantity of oil in the filling soaking bath the pebble elevation increased and upon decreasing the quantity of oil the pebble decreased. Refer to Plate D for photographs of the fabric made in this group.

Group E—Variations in the Ratio of Sulfonated Oil to Cocoanut Oil in the Filling Soaking Bath

The composition of the oil used in the filling soaking bath had a decided influence upon the pebble of the finished fabric. When the oil used contained more sulfonated olive oil than so-called raw cocoanut oil the pebble elevation of the finished fabric increased and when the oil contained more raw cocoanut than sulfonated olive oil the pebble decreased in elevation. The increased use of raw cocoanut oil also caused the fabric to dye darker.

Group F—Variations in the pH of the Filling Soaking Bath

The pH of the filling soaking bath had an influence upon the pebble of the finished fabric. Acid baths increased the pebble and slightly alkaline baths also increased the pebble. The lowest pebble was obtained from the filling that was soaked in the neutral or nearly neutral baths.

Refer to Plate F for photographs of the fabrics made in this group.

Group G—Variations in the Filling Skein Extraction After Soaking

Variations in skein extraction had no effect upon the pebble of the finished fabric. When the quantity of ingredients in the soaking bath was increased and the extraction increased the pebble decreased slightly, and when the quantity of ingredients were decreased and the extraction time decreased the pebble increased slightly indicating that direct changes in the quantity of ingredients had more effect upon the pebble than variations in only extraction.

NOTE:—Although the variations in extraction in this work produced no changes in pebble it is recommended that the extraction time be uniformly maintained in commercial practice.

Group H—Variations in Filling Skein Drying After Soaking

Variations in the drying of the skeins of filling yarn after soaking had little effect upon the pebble of the finished fabric. The yarn dried at high temperature dyed lighter than the yarn dried at low temperature. Refer to Plate H for photographs of the fabric made in this group.

Group I—Variation in the Tension Used on the Warp and Filling Yarn in Throwing and Weaving Plants

The range of variations in tension found to exist in better controlled throwing and weaving plants was found to have no appreciable effect upon the pebble of the finished fabric. Refer to Plate I for photographs of the fabric made in this group.

Group J—Variations in Twist Setting or Steaming

The length of steaming time had no effect upon the pebble of the finished fabric. Extreme variations in the temperature and relative humidity of the steaming oven influenced the pebble of the finished fabric and as in skein drying the yarn steamed at high temperatures dyed lighter than yarn steamed at low temperatures. Refer to Plate J for photographs of the fabrics made in this group.

Group K—Variations in Cop Steaming or Conditioning

Cop steaming or variations in this process had no effect upon the pebble of the finished fabric. Refer to Plate K for photographs of the fabric made in this group.

Group L—Variations in Warp Sizing

Variations in the nature of the warp sizing had some influence upon the pebble of the finished fabric. Hard warp sizing resulted in a slightly higher pebble than the medium and soft warp sizing.

SCOPE

This investigation was devoted to creating intentionally variations in the individual operations in the manufacture of rayon crepe dress fabrics, then processing yarns and fabrics under the conditions created to find the influence of these variations upon the finished fabric. In this connection approximately 2,000 yards of fabric were woven, dyed and finished. Since the filling yarn exerts the major influence upon the type of crepe produced in the finished fabric, most of the work in this investigation was confined to the processing of filling yarns, although a few of the major warp factors were also investigated.

The work included an investigation of the effects of the following:

Group A: Variations in the total quantity of ingredients in the filling soaking bath.
Group B: Variations in the jelly strength of the gelatin used in the filling soaking bath.
Group C: Variations in the ratio of gelatin to dextrine in the filling soaking bath.
Group D: Variations in the quantity of oil in the filling soaking bath.
Group E: Variations in the ratio of sulfonated olive oil to cocoanut oil in the filling soaking bath.
Group F: Variations in the pH of the filling soaking bath.
Group G: Variations in the extraction of the filling skeins after soaking.
Group H: Variations in filling skein drying after soaking.
Group I: Variations in the tension used on the warp and filling yarns in throwing and weaving plants.
Group J: Variations in twist setting or steaming.
Group K: Cop steaming or conditioning.
Group L: Variations in the warp sizing.

Equipment and Formulae Used

The plants in which the work was done were selected by the Committee because (1) they were representative of the industry and (2) they were able to furnish the exacting control necessary for this type of research and they were representative of good practice in the industry.

The methods of processing and formulae used in this investigation were not the standard practices of the plants in which the work was done but were selected or approved by the Committee.

The base formulae used were selected by the Committee after numerous inquiries into commercial formulae. They contained the ingredients and approximate proportions generally used commercially.

The choice by the Commtitee, however, is not intended to be a recommendation of the formulae or ingredients.

Control Instruments

The instruments used in controlling and recording the conditions under which the yarns and fabrics in this investigation were processed were the same ones used in the surveys of the numerous throwing and weaving plants (Part No. 1 in this report), and in the manufacture of 500 yards of fabric in Part No. 4. Periodic checks were made on the instruments to verify their accuracy.

Yarns and Fabric

The great amount of detail involved in this investigation precluded the possibility of experimenting with more than

one type of warp yarn, one type of filling yarn and one fabric construction. The warp yarn used was from one lot and shipment and the filling yarn was from one lot and shipment, each drawn at random from the regular production of the respective companies who donated the yarn for this research.

The filling yarn was tested thoroughly to determine the degree with which it conformed to other commercial deliveries of similar yarns in uniformity (Part No. 6). Five hundred yards of finished fabric were previously made from the warp and filling yarns to determine the extent of variations in pebble to be expected in the finished cloth when manufactured by the base methods adopted for this research (Part No. 4).

The filling yarn was divided into several units and from three to nine units were processed in one group. For instance there were five units processed in Group A and three units in Group B, etc.

For comparative purposes a standard or reference control unit was processed along with the specially treated units in each group. By following this procedure the standard or reference control unit was subjected to the same general conditions and uncontrollable influences as the other units in the group. For descriptive purposes these units will be called "control units" in this report.

The same warp yarn was used in all of the groups. The warps were all made from the same cones so that all of the fabric contained the same warp ends. The fabric selected and made was a type particularly susceptible to variations in pebble elevation and filling bandiness. The construction was as follows:

	Warp Yarn	*Filling Yarn*
Type	Acetate Rayon	Viscose Rayon
Luster	Dull	Semi-Dull
Denier	150	200
Filaments	60	75
Twist	3.5	50
Ends per inch	Warp 96	Filling 48

Reed width, 47"....

Weave—Plain, alternating 4 picks of "S" and 4 picks of "Z" twist.

Standard Procedures

Many of the units and groups in this investigation were processed in an identical manner in several of the operations. For instance, all of the groups in which only the filling yarns were soaked differently, were processed alike in all of the subsequent operations and as many groups as possible were processed at the same time and under the same conditions.

The methods used in processing "Group A" will be described in detail but in describing the methods used in the subsequent groups any similarity in processes and equipment will be referred to "Group A."

In the groups where changes were made in equipment or methods, or variations created, the equipment and methods used will be fully described.

Preparation of the Warp Yarn

Since the same method was used in preparing all the warps in this research, except those used in Group L, the method used will be described in detail here and will not be repeated in the description of the methods of the individual groups. The method used in preparing the warps, used in all the groups in this part except Group L, was as follows:

Warping

The warp yarn was received at the weaving plant on two pound cones. A warp was made directly from the cones on a Sipp-Eastwood horizontal automatic cone creel warper which was operated at 200 yards per minute. The warp consisted of 19 sections totaling 4740 ends and was 1300 yards long.

Slashing

The warp was sized on a Johnson rayon slasher. The details of this operation were as follows:

Number of drying cylinders..... 5

Cylinder No. 1 was covered with cloth while the others were bare.

Circumference of drying cylinders 70 inches

Temperature of drying cylinders.. 1st—150° F.
2nd, 3rd, 4th—170° F.
5th—140° F.

Running speed of warp..... 18 to 20 yds. per min.

Stretch of yarn..... 3 per cent

Warp Size Formula

The warp size formula used was as follows:

1600 lbs. of water
64 lbs. of gelatin
15 lbs. of softener (oil)
1 lb. of stearic acid

The characteristics of the gelatin were as follows:

Jell-Strength—396 Viscosity—127

The viscosity and jell-strength were determined in accordance with the standard methods of the National Association of Glue Manufacturers, Inc. The jelly tests were made at a 7-1 concentration; i.e., on the glue basis.

The softener or oil was a mixture of cocoanut and sulfonated olive oils conforming to the following analysis:

Moisture	15%
SO_3	4%
Free Fatty Acid	7–8
Ash	4.5%
Unsaponifiable	Nil

It gave a stable light opalescent emulsion in water.

Preparation of Warp Size

The gelatin was steeped in cold water for four hours, then warmed gradually to 140° F. and stirred gently until it was completely dissolved. The stearic acid was melted, mixed with the oil then added to the gelatin solution.

This solution was poured into the slasher and the same solution was used for replenishing.

Warp Characteristics

The sized warp had good cohesion, was of medium softness, flexible and wove excellently.

Weaving

Except in Group "I" the same method was used in weaving all the groups in this part. The details of this operation were as follows for all the groups except Group "I."

Approximately 20 yards of continuous fabric were woven from each unit of filling yarn and one of the research warps. Cops of the various filling units were also alternated in the fabric to bring the units next to each other so that after dyeing and finishing any differences from unit to unit could be easily noticed. To eliminate the necessity of stopping the loom at shuttle changes thereby preventing the possibility of stop marks at these points, the alternating of the units was accomplished by placing two full shuttles of one unit in the boxes and two full shuttles of the second unit in the magazine of the loom. When the shuttles weaving in the loom were empty they were automatically changed. Since it was essential that both shuttles be changed almost simultaneously the loom had to be given constant attention so that in the event one cop became empty before the other both shuttles would be ejected at the same time. This was done by lowering both automatic shuttle selectors at the same time when ths weaving shuttles were almost empty. Where several different units were being alternated, as this group, the magazine was replenished with the desired units.

The weaving specifications used were as follows:

Make of loom	Crompton & Knowles
Type	2x1 automatic, shuttle change
Running speed	140 picks per minute
Number of harnesses used	6
Type of let-off motion	rope
Ends per dent in reed	3
Ends per heddle eye	1
Draw	1-6-4-2-5-3
Spread of yarn in reed	47 inches
Average warp tension as recorded by Crompton & Knowles warp tension meter	50 ends read 50 to 60
Atmospheric conditions (Average)	Temperature—85° F. Relative Humidity—54.0%

Dyeing and Finishing

All of the pieces in Part No. 5 were dyed and finished in the same manner by methods which conformed closely to general trade practices. The pieces contained several groups, therefore, all of the groups and units in this investigation were dyed and finished in an identical manner. None of the fabric in this part was embossed.

The detail methods used in dyeing and finishing the pieces were as follows:

Marking and Beaming

The pieces were carefully marked for identification with indelible pigment, were sewed together and beamed into continuous lengths of about 300 yards each.

Boil-Off

The scouring was done on a continuous boil-off machine consisting of two separate units. The first unit consisted of a rectangular tank approximately 30 feet long, 6 feet wide and 6 feet deep in which the bath was maintained at a temperature of 180° F. The purpose of the first unit was to shrink the fabric in flat form. It was equipped so that the fabric was passed through with a minimum of tension in either warp or filling-wise direction. The cloth was fed into the bath from above at one end and was drawn off at the other. The only tension used was that necessary to draw the fabric through the bath and lift it out of the tank. At no time was the fabric allowed to sink to the bottom of the tank or accumulate at any one point. The fabric was drawn off the first unit still in flat form, then converted through eyes into rope form and fed into the second unit. The second unit consisted of several individual compartments through which the fabric was continuously passed in rope form. The first individual compartments contained a 0.5 per cent soap solution, whereas the last units were used entirely as rinses. Upon completing the cycle the fabric was fed from the machine on to a table. The goods were in the boil-off machine for a total of 25 minutes.

The pieces were individually segregated and examined to determine whether any further processing might be necessary to assure complete removal of tint and manufacturing dirt. These pieces required no further processing.

Dyeing

The pieces were dyed in an ordinary beck in rope form. They were entered into a cold bath consisting of water, circulated a few minutes to insure complete wetting out then the following dyes and assistants were introduced:

For Dyeing the Acetate Rayon

0.05% Setacyl Direct Blue G (41%)
0.02% Calconese Yellow GC
0.03% Calconese Red Violet R Double
0.02% Artisil Red SY

For Dyeing the Viscose Rayon

0.10% Direct Pure Blue RC
0.04% Brilliant Benzo Violet B

For exhausting and assisting 0.10 per cent of Glauber's salt and 0.02 per cent of Naccanol were used in the bath. All of the percentages were calculated on the weight of the fabric.

The temperature was gradually raised up to the boil and the pieces were circulated for four hours to insure complete penetration of the dye. After this period the dye bath was flooded off and the goods rinsed first in warm water then in cold water for one-half hour. After the application of a

finishing solution in the last rinse the pieces were removed from the box and sent for extraction.

Extracting

The goods were extracted until the bulk of the water was removed.

Drying

The pieces were dried on the standard dye-house loop or slack type drier the goods being continuously carried through the dryers in festoon form.

Re-Beaming

The pieces were sewn together again, spread out and wound into rolls of about 200 yards in length in preparation for the tentering process.

Tentering

The goods were tentered on a tentering frame equipped with wet steam jets which released wet steam upon fabric at the entering end of the frame. The goods were passed over hot steam coils which dried them while being spread to 39″ width. After tentering they were finally segregated into the individual pieces, re-rolled and examined.

Method of Pebble Evaluation

The units of finished fabric in each group were carefully examined, compared with each other and the character and elevation of pebble evaluated.

There are several arbitrary methods of measuring pebble elevation which are satisfactory for laboratory evaluations but in actual commercial practice the character and elevation is visually evaluated. The grading of the pebble elevation in this investigation was done visually and in accordance with the methods used in commercial practice. The pebble of each unit was classified, then each unit was photographed. The photographs are shown in this report.

In each group the control unit was used as a basis for judging the other units in the group. By this method the trend or direction produced by the changes in processes could be followed.

GROUP A
THE EFFECTS OF VARIATIONS IN THE TOTAL QUANTITY OF INGREDIENTS IN THE FILLING SOAKING BATH

To determine the effects of variations in the total quantity of ingredients in the filling soaking bath, five units of filling yarn were soaked, thrown, woven into fabric, dyed and finished. The individual units were soaked in separate baths having different quantities of the same ingredients and then were processed in exactly the same manner in all of the subsequent operations.

The units were identified as follows:

Unit No.

1—Control unit
2—Filling soaking bath ingredients reduced 30%
3—Filling soaking bath ingredients reduced 60%
4—Filling soaking bath ingredients increased 30%
5—Filling soaking bath ingredients increased 60%

Preparation of the Filling Yarn

The filling yarn was received from the rayon manufacturer in skein form packed in the usual 10 pound bundles, there being equal amounts of "S" and "Z" initial twist yarn. Five units were prepared for this group, each consisting of equal parts of "S" twist and "Z" twist yarn. The five units were soaked by the standing bath or tub method in ten separate baths, the "S" and "Z" twist in each unit being treated the same.

The baths contained the following ingredients and proportions:

Unit No.	1	2	3	4	5
Gelatin	1.25 lbs.	.87 lbs.	.5 lbs.	1.62 lbs.	2.0 lbs.
Dextrine	1.25	.87	.5	1.62	2.0
Oil	18	12.6	7.2	23.4	28.8

Soft water was added to bring the total volume of each bath to 55 gallons.

The proportions were based on 110 pounds of yarn.

Although the quantity was different the same ingredients were used to soak all of these units. Their characteristics were as follows:

Gelatin:

Jell-Strength—372 Viscosity—132 pH—5.8

The viscosity and jelly strength was determined in accordance with the standard methods of the National Association of Glue Manufacturers, Inc. The jelly tests were made at a 7-1 concentration; i.e., on the glue basis.

The pH determinations were made on the test samples after the jelly test had been made by remelting and determining the pH of the solution at 60° C. by a colormetric method with a La Motte roulette comparator using brom thymol blue and chlor phenol red.

Dextrine:

Manufactured from Tapioca Starch
Color—Light Canary
Solubility—99% plus
Specific Rotation (25° C.)—164
Dextrine by Polarization (25° C.)—87.5%
Dextrose 2.07%
Ash 0.10%

Oil:

The oil was a mixture of cocoanut and sulfonated olive oils conforming to the following analysis:

Moisture	15%
SO_3	4%
Free Fatty Acid.....	7–8
Ash	4.5%
Unsaponifiable	Nil

It gave a stable light opalescent emulsion in water.

Filling Soaking Procedure

The same procedure was used in preparing all of the baths in which the units in this group were soaked. Two baths were used to soak each unit, one for "S" twist yarn and one for "Z" twist yarn. In each unit the baths used for the "S" twist yarn contained exactly the same ingredients and proportions as the one used for the "Z" twist yarn.

The procedure used in preparing the baths was as follows: The baths were started by running water into the tubs until about half the volume was reached. The gelatin and dextrine was then steeped in a separate container for a few minutes in cold water, gently stirred, then heated to 140° F. and stirred until fully dissolved. The solution was then poured through a filter into the baths. The oil was then poured through the filter into the baths and the tint which had been previously dissolved in water was filtered and added to the baths. Sufficient water was then added until the total volume was reached. The temperature was raised to 125° F. and the baths were thoroughly stirred with an electric propeller stirrer.

The rolls of skeins were opened and submerged in the baths for thirty minutes. They were then removed, allowed to drain three minutes and extracted. Since the units consisted of small quantities the skeins were not wrapped for soaking.

Extraction

Each unit was wrapped in coarse mesh bags and extracted individually but they were all extracted the same length of time. Although the best possible control was exercised over this operation, there were some slight differences from unit to unit and between the "S" and "Z" twist yarns within the units.

The extracted weights exceeded the original weights by the following amounts:

	Gain over the original weights
Unit No. 1—"S" Twist Yarn	88.0%
"Z" Twist Yarn	88.0%
Unit No. 2—"S" Twist Yarn	85.0%
"Z" Twist Yarn	88.0%
Unit No. 3—"S" Twist Yarn	85.0%
"Z" Twist Yarn	85.0%
Unit No. 4—"S" Twist Yarn	97.0%
"Z" Twist Yarn	97.0%
Unit No. 5—"S" Twist Yarn	85.0%
"Z" Twist Yarn	91.0%

The extracted skeins were gently shaken out manually and were hung on the poles of the drier trucks.

NOTE: The difficulty in controlling the extraction process is indicated by the variations from "S" to "Z" twist. In Unit No. 5 there was a difference of 6.0 per cent in weights in spite of the fact that both "S" and "Z" had precisely the same original weights and were extracted at the same time.

These differences had no effect upon the pebble of the finished fabric. See Group G for the results of an investigation of differences in extraction time.

Drying

All of the units in this group were placed in the drying oven at the same time and allowed to remain in the oven the same length of time. The temperature of the oven was maintained at 150° F. ± 5° F. The yarn was allowed to remain in the oven for about three hours or until it contained 5.4 per cent moisture. Upon its removal from the oven the yarn was placed in the humidified winding room for 48 hours before it was wound to give it an opportunity to come to equilibrium with the atmosphere in which it was wound.

Winding

The five units of yarn in this group were wound on the same machines at the same time and under the same conditions. The method used in winding was as follows:

Make of winders	*Atwood
Make of swifts	*Atwood wire, adjustable hub
Weight on swift axles	12 ounces
Length of yarn under strain	19½ inches
Linear running speed of yarn (Yards per minute)	Minimum—100
	Maximum—175
Atmospheric conditions (average)	Temperature—80° F.
	Relative humidity—55.0%

Tension or Strain on the Yarn During Winding:

Range Tension (Grams)	*Per Cent of Ends*
21 to 25	.8%
26 to 30	11.2
31 to 35	29.0
36 to 40	38.8
41 to 45	18.6
46 to 50	1.6

Twisting or Throwing

The five units were twisted or thrown on the same machines at the same time under the same conditions. The method used was as follows:

Make of twisters	Atwood, double deck
Spindle speeds	10,000 R.P.M.
Length of yarn under strain	12 inches
Twist per inch	50
Flyer used:	
Make—McHale	
Type—4 Arm, mill nut	
Weight—No. 10 wire	
Atmospheric conditions (average)	Temperature—84° F.
	Relative humidity—52.0%

Tension or Strain on the Yarn During Twisting:

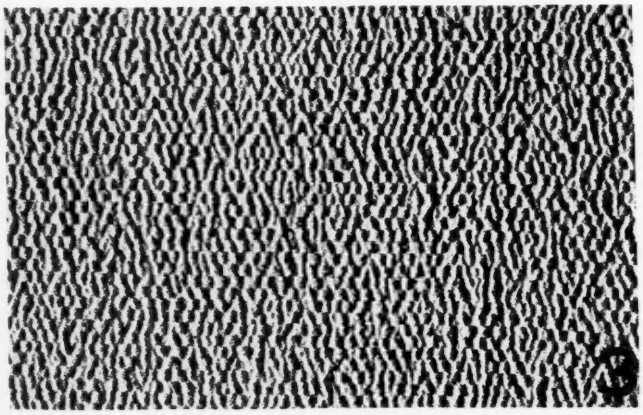
Range Tension (Grams)	*Per Cent of Ends*
11 to 15	18.5%
16 to 20	43.5
21 to 25	35.5
26 to 30	2.5

Twist Setting or Steaming

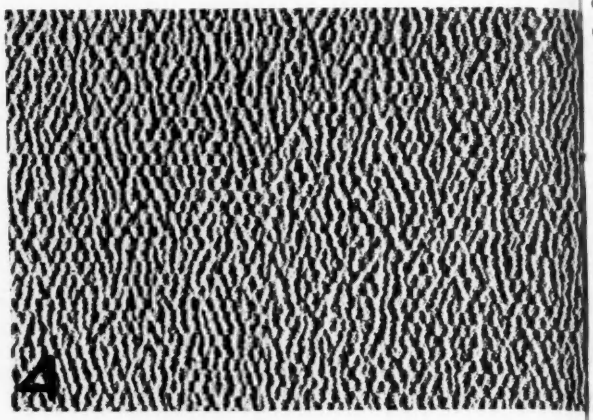
To set the twist the five units of yarn were placed in a Lydon electric steam box at the same time. The box was maintained at 180° F. dry bulb and 175° F. wet bulb (89 per cent relative humidity) and the yarn was allowed to remain in the box continuously for 3½ hours under these conditions. The yarn was then removed and placed

PLATE A

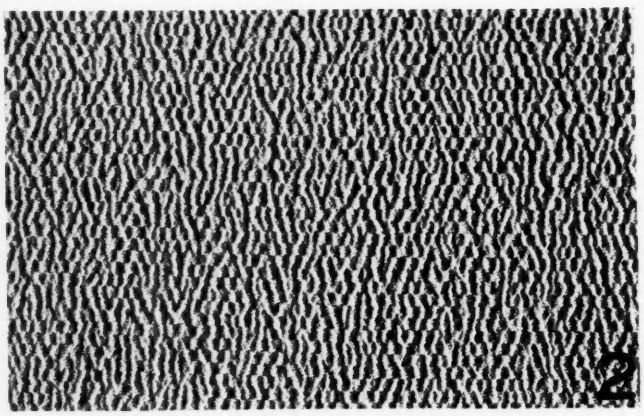
The Effect of Variations in the Total Quantity of the Ingredients in the Filling Soaking Bath



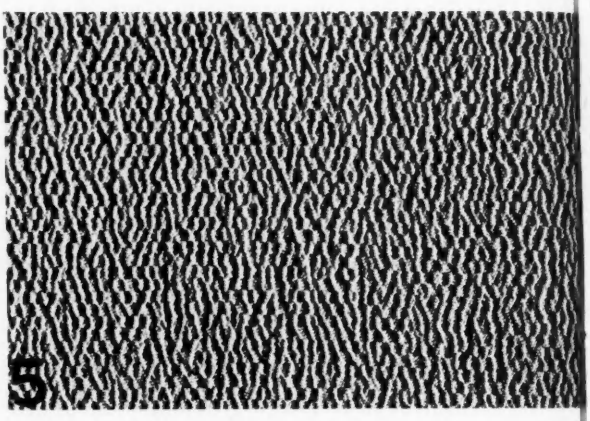
Unit No. 3—Filling soaking bath ingredients reduced 60%.



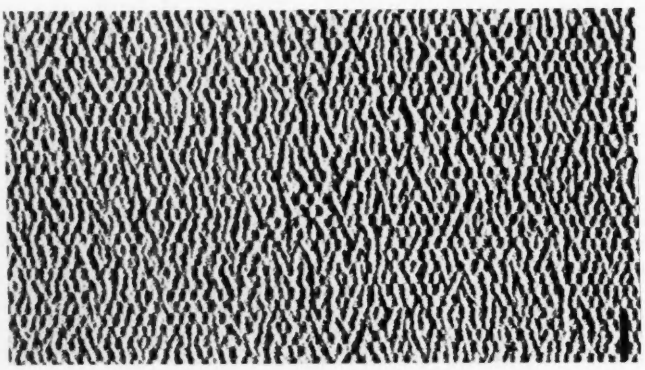
Unit No. 4—Filling soaking bath ingredients increased 30%



Unit No. 2—Filling soaking bath ingredients reduced 30%.



Unit No. 5—Filling soaking bath ingredients increased 60%



Unit No. 1—Control unit.

in the humidified redrawing room for twelve hours before redrawing.

Redrawing

The five units in this group were redrawn on to shipping spools at the same time under exactly the same conditions.

The method of redrawing was as follows:

Make of machines.....	*Atwood
Running speed of yarn (Yards per minute).. ..	Minimum—140 Maximum—300
Length of yarn under strain.	18 inches
Atmospheric conditions (average)	Temperature—86.5° F. Relative humidity—57.0%

Tension or Strain on the Yarn During Redrawing:

Range Tension (Grams)	*Per Cent of Ends*
16 to 20.....	2.7%
21 to 25.....	6.7
26 to 30.....	44.0
31 to 35.....	32.0
36 to 40.....	10.6
41 to 45.....	2.7
46 to 50.....	1.3

The spools of yarn were wrapped, packed into cases and shipped to the weaving plant.

Copping or Quilling

In the weaving plant all of the five units were copped or quilled at the same time under the same conditions. The copping specifications were as follows:

Make of machines..... Universal (Leesona)
Spindle speeds ..... 2200 R.P.M.
Tension compensators ..... Flat wire with revolving porcelain pulleys
Atmospheric conditions
(Average) ..... Temperature—78° F.
Relative humidity—50.0%

Tension or Strain on the Yarn During Copping:

Range Tension (Grams)	Per Cent of Ends
51 to 55	.7%
56 to 60	15.8
61 to 65	52.7
66 to 70	28.9
71 to 75	1.9

Evaluation of the Pebble of the Finished Fabrics in Group A

The examination of the units of finished fabric in Group "A" showed that the pebble was affected by variations in the total quantity of ingredients used in the filling soaking bath.

The finished fabric in unit No. 2 had a slightly lower pebble than the control unit No. 1, whereas unit No. 3 had appreciably more pebble than the control unit No. 1.

The pebble in unit No. 4 was the same as the control unit No. 1 while unit No. 5 was slightly lower.

This investigation showed that a decrease of 30 per cent in the total ingredients in the filling soaking bath reduced the pebble slightly but a decrease of 60 per cent increased the pebble appreciably. It also showed that an increase of 30 per cent and 60 per cent in the total ingredients in the filling soaking bath only tended to reduce the pebble in the finished fabric slightly. The accompanying photographs in Plate A show the differences in pebble produced by these variations.

GROUP B

THE EFFECTS OF VARIATIONS IN THE JELLY STRENGTH OF THE GELATIN USED IN THE FILLING SOAKING BATH

To determine the effects of variations in the jelly strength and other characteristics of the gelatin used in the filling soaking bath three (3) units of filling yarn were soaked, thrown, woven into fabrics, dyed and finished. The only differences between the units were the gelatins used in the filling soaking baths.

The units were identified as follows:

Control
Unit No. 6—Commercial 200 jelly strength gelatin
Unit No. 7—Commercial 350 jelly strength gelatin
Unit No. 8—Commercial 500 jelly strength gelatin

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the following ingredients and proportions:

Units No. 6—No. 7—No. 8—"S" and "Z" Twist Yarn

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

The characteristics of gelatins used in these units were as follows:

Unit No.	*Jelly Strength*	*Viscosity*	*pH*
6	256	80	5.8
7	372	132	5.8
8	465	157	5.8

The viscosity and jelly strength was determined in accordance with the standard methods of the National Association of Glue Manufacturers, Inc. The jelly tests were made at a 7-1 concentration; i.e., on the glue basis.

The pH determinations were made on the test samples after the jelly test had been made by melting and determining the pH of the solution at 60° C. by a colormetric method with a La Motte roulette comparator using brom thymol blue and chlor phenol red.

The same type of dextrine was used in all of the formulae in this group. It was manufactured from tapioca starch and conformed to the following specifications:

Color ..... Light canary
Solubility ..... 99% plus
Specific Rotation (25° C.)..... 164
Dextrine by polarization (25° C.)..... 87.5%
Dextrose 2.07%
Ash 0.10%

The same type of oil was used in all of the formulae in this group. It was a mixture of cocoanut and sulfonated olive oils conforming to the following analysis:

Moisture 15%
SO_3 ..... 4%
Free fatty acid..... 7–8
Ash 4.5%
Unsaponifiable ..... Nil

It gave a stable light opalescent emulsion in water.

Filling Soaking Procedure

The filling soaking procedure was exactly the same as Group "A." Refer to Group "A" for details.

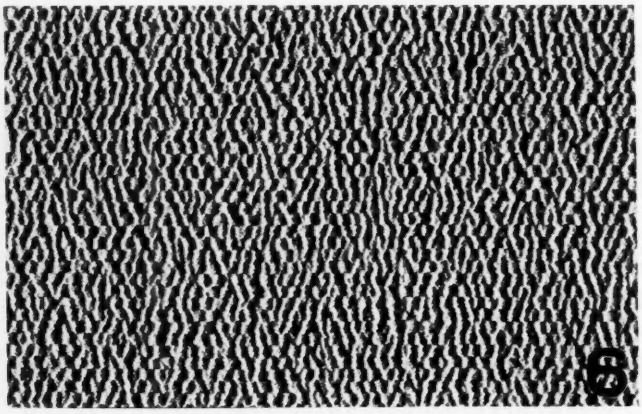
Extraction

Each unit was extracted individually but they were all extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

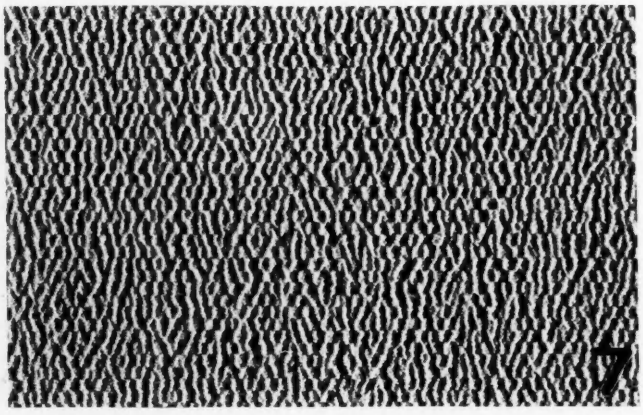
	Gain over the original weights
Unit No. 6—"S" Twist Yarn.....	85%
"Z" Twist Yarn.....	88
Unit No. 7—"S" Twist Yarn.....	91
"Z" Twist Yarn.....	88
Unit No. 8—"S" Twist Yarn.....	88
"Z" Twist Yarn.....	88

PLATE B

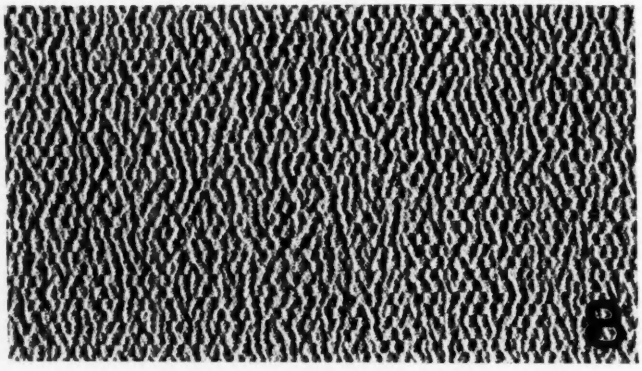
The Effects of Variations in the Jelly Strength of Gelatin Used in the Filling Soaking Bath



Unit No. 6—Commercial 200 Jelly Strength Gelatin.



Unit No. 7—Commercial 350 Jelly Strength Gelatin.



Unit No. 8—Commercial 500 Jelly Strength Gelatin.

The extracted skeins were gently shaken out manually and were hung on the poles of the drier trucks.

Drying, Winding, Twisting, Redrawing, Copping, Weaving, Dyeing and Finishing

The units in this group were all processed in the same manner in the drying, winding, twisting, twist setting, redrawing, copping, weaving, dyeing and finishing operations. (Refer to Group "A" for details of these operations.)

Evaluation of the Pebble of the Finished Fabrics in Group B

This investigation showed that variations in the jelly strength of the gelatin used in the filling soaking bath had very little effect upon the pebble of the finished fabric. See photographs in Plate B.

The photographs in Plate B show the slight differences between these units.

GROUP C

THE EFFECTS OF VARIATIONS IN THE RATIO OF GELATIN TO DEXTRINE IN THE FILLING SOAKING BATH

To determine the effects of variations in the ratio of gelatin to dextrine in the filling soaking bath, five units of filling yarn were soaked, thrown, woven into fabric, dyed and finished. These units were soaked in separate baths which contained different proportions of gelatin and dextrine. All the other ingredients were the same in each bath and the units were processed in an identical manner in all of the subsequent operations.

The units in this group were identified as follows:

Unit No. 9—All dextrine
Unit No. 10—75% dextrine, 25% gelatin
Control Unit No. 11—50% dextrine, 50% gelatin
Unit No. 12—25% dextrine, 75% gelatin
Unit No. 13—All gelatin

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the following ingredients and proportions:

Unit Nos. ("S" and "Z" Twist Yarn)	9	10	11	12	13
Gelatin		.63 lbs.	1.25 lbs.	1.87 lbs.	2.5 lbs.
Dextrine	2.5 lbs.	1.87	1.25	.63	
Oil	18	18	18	18	18

Soft water to bring the total volume of the baths to 55 gals.
110 lbs. of yarn

Although the proportions of gelatin and dextrine were varied the same ingredients were used in all of the baths. Their characteristics were the same as those used in soaking the filling in Group "A."

Filling Soaking Procedure

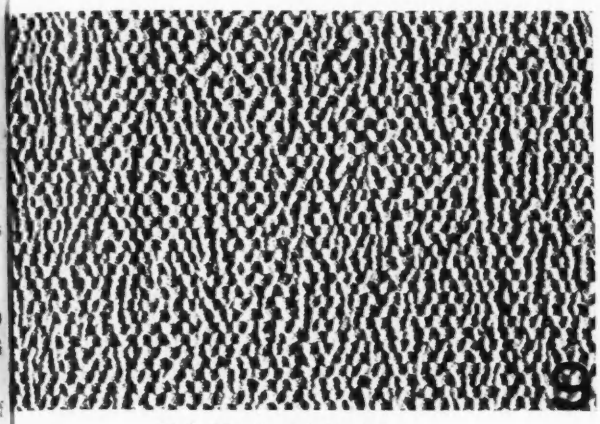
The filling soaking procedure was exactly the same as "Group "A."

Extraction

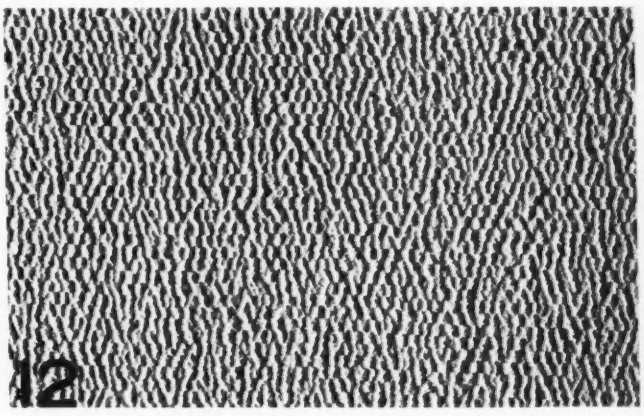
Each unit was extracted individually but all were extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

PLATE C

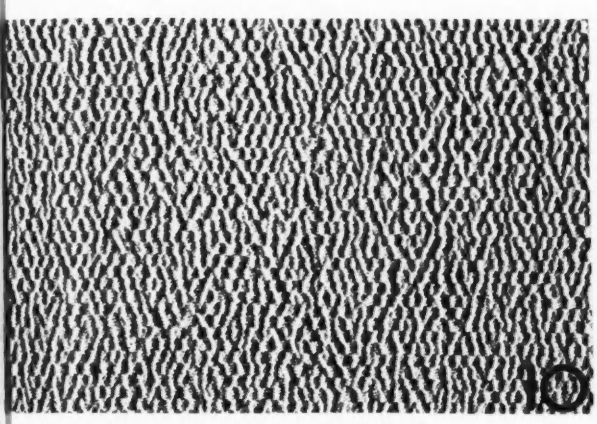
The Effects of Variations in the Ratio of Gelatin to Dextrine in the Filling Soaking Bath



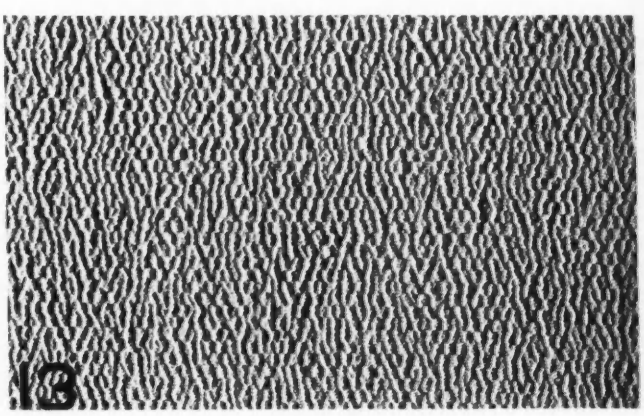
Unit No. 9—All Dextrine.



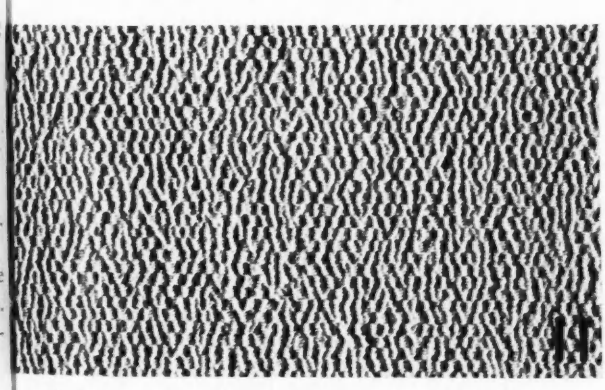
Unit. No. 12—25% Dextrine, 75% Gelatin.



Unit No. 10—75% Dextrine, 25% Gelatin.



Unit No. 13—All Gelatin.



Unit No. 11—Control Unit—50% Dextrine, 50% Gelatin.

		Gain over the original weights
Unit No. 9—	"S" Twist Yarn	85%
	"Z" Twist Yarn	91%
Unit No. 10—	"S" Twist Yarn	91%
	"Z" Twist Yarn	88%
Control Unit No. 11—	"S" Twist Yarn	85%
	"Z" Twist Yarn	85%
Unit No. 12—	"S" Twist Yarn	88%
	"Z" Twist Yarn	88%
Unit No. 13—	"S" Twist Yarn	85%
	"Z" Twist Yarn	91%

The extracted skeins were gently shaken out manually and were hung on the poles of dryer trucks.

Drying, Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing:

The units in this group all were processed in the same manner in the drying, winding, twisting, setting, redrawing, weaving, dyeing and finishing operations. (Refer to Group "A" for the complete details of these operations).

Evaluation of the Pebble of the Finished Fabrics in Group C

The use of dextrine alone as a filling size resulted in an extremely high pebble in the finished fabric but the fabric had pronounced "cracks" or warpwise streaks and creases. The substitution of 25 per cent gelatin for 25 per cent of

the dextrine sharply decreased the pebble and brought it under much better control. As the quantity of gelatin was further increased and the dextrine decreased the pebble became correspondingly lower and more uniform in character.

This investigation showed that the ratio of gelatin to dextrine in the filling soaking bath is much more important than the total weight of the combined gelatin and dextrine. (See Group A).

The results in this group should be considered in relationship to the results obtained in both Groups D and E ("Variations in the Quantity of Oil" and "Variations in the Ratio of Raw and Sulfonated Oil").

The photographs in Plate C showed the differences in pebble obtained by varying the ratio of gelatin to dextrine.

GROUP D

THE EFFECTS OF VARIATIONS IN THE QUANTITY OF OIL IN THE FILLING SOAKING BATH

A group of six units of filling yarn was soaked, thrown, woven into fabric, dyed and finished to determine the effects of variations in the quantity of oil used in the filling soaking baths. The oil used to soak all of these units was the same except that different quantities were used. All the other ingredients in the baths were kept constant. The units were soaked in different baths but were processed through the throwing, weaving, dyeing and finishing plants in exactly the same manner.

The units were identified as follows:

Unit No. 14 —Oil increased 30%
Unit No. 15 —Oil increased 60%
Unit No. 15A—Oil increased 100%
Unit No. 16 —Oil decreased 30%
Unit No. 17 —Oil decreased 60%
Unit No. 17A—Control unit

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the following ingredients and proportions:

Unit Nos. ("S" and "Z" Twist Yarn)	14	15	15A	16	17	17A
Gelatin	1.25 lbs.	1.25 lbs.	1.25 lbs.	1.25 lbs.	1.25 lbs.	1.25 lbs.
Dextrine	1.25	1.25	1.25	1.25	1.25	1.25
Oil	23.4	28.8	36.0	12.6	7.2	18

Soft water to bring the total volume of the baths to 55 gals.
110 lbs. of yarn.

The same ingredients were used in all of the baths. Their characteristics were the same as those used in soaking the filling in Group "A" (Refer to Group "A" for complete details).

Filling Soaking Procedure

The filling soaking procedure was exactly the same as Group "A."

Extraction

Each unit was extracted individually but all were extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

	Gain over the original weights
Unit No. 14 —"S" Twist Yarn.....	91%
"Z" Twist Yarn.....	91%
Unit No. 15 —"S" Twist Yarn.....	91%
"Z" Twist Yarn.....	94%
Unit No. 15A—"S" Twist Yarn.....	88%
"Z" Twist Yarn.....	94%
Unit No. 16 —"S" Twist Yarn.....	94%
"Z" Twist Yarn.....	94%
Unit No. 17 —"S" Twist Yarn.....	91%
"Z" Twist Yarn.....	85%
Unit No. 17A—"S" Twist Yarn.....	83%
"Z" Twist Yarn.....	85%

The extracted skeins were shaken out manually and hung on the poles of drier trucks.

Drying, Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing

The units in this group were all processed in the same manner in the drying, winding, redrawing, twisting, twist setting, copping, weaving, dyeing and finishing operations. (Refer to Group "A" for complete details of these operations.)

Evaluation of the Pebble of the Finished Fabrics in Group D

The pebble of the finished fabric was appreciably affected by variations in the quantity of oil used in the filling soaking bath. The finished fabrics showed that when the quantity of oil in the filling soaking bath was reduced the pebble of the finished fabric was proportionately reduced and when the quantity of oil was increased the pebble increased in elevation.

Beginning with the control unit No. 17A, the rate of reduction in pebble resulting from reducing the quantity of oil was gradual. However, an increase in quantity of 30 per cent resulted in a slight decrease in pebble whereas increases of 60 per cent and 100 per cent resulted in substantial increases in pebble.

The results obtained indicate that variations of not more than 30 per cent above or below the control unit would not cause any significant change in pebble in the manufacture of rayon crepe fabrics. The photographs in Plate D show the differences in pebble obtained by varying the quantity of oil.

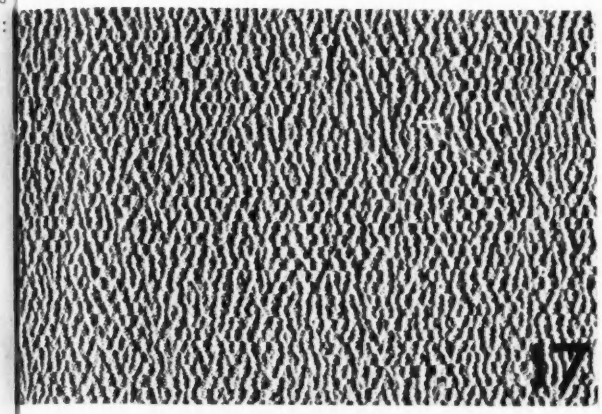
GROUP E

THE EFFECTS OF VARIATIONS IN THE RATIO OF SULFONATED OLIVE OIL TO COCOANUT OIL IN THE FILLING SOAKING BATH

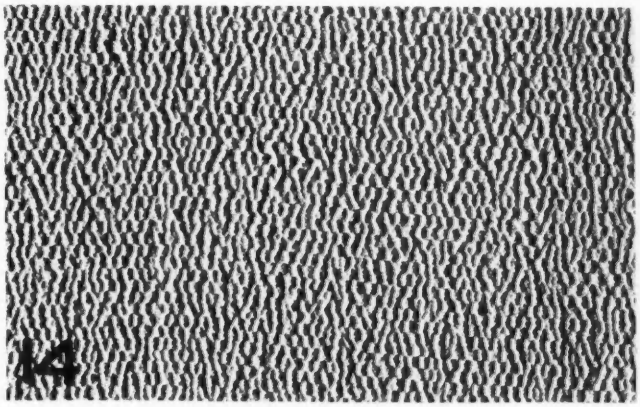
Many of the oils used in this country for soaking rayon yarns for crepe purposes have consisted of mixtures of sulfonated olive oil and so-called raw cocoanut oil.

PLATE D

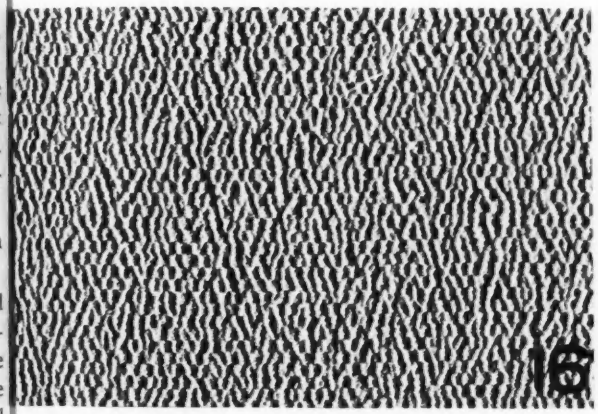
The Effects of Variations in the Quantity of Oil in the Filling Soaking Bath



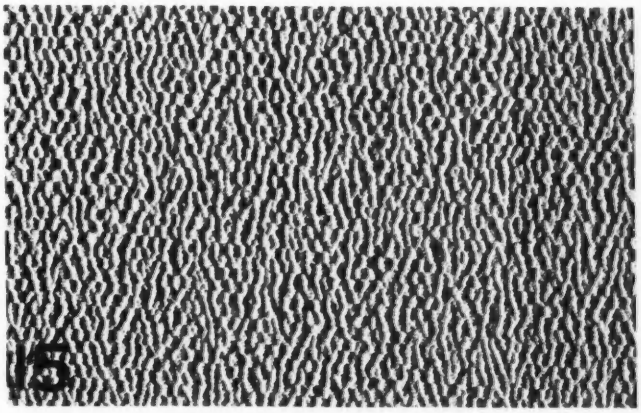
Unit No. 17—Oil decreased 60%.



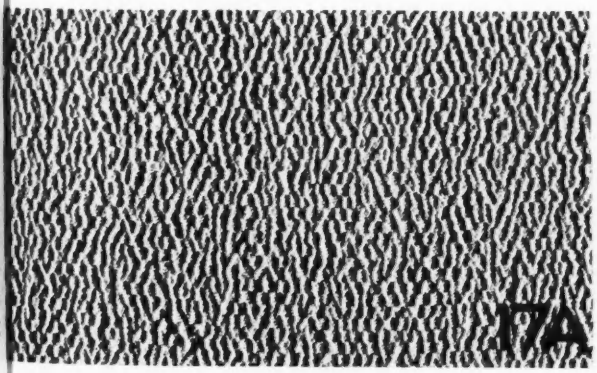
Unit No. 14—Oil increased 30%.



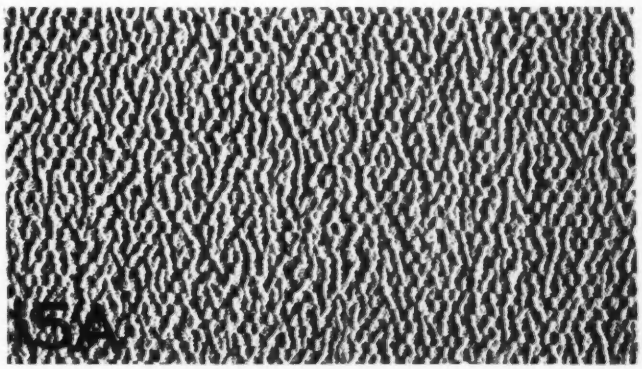
Unit No. 16—Oil decreased 30%.



Unit No. 15—Oil increased 60%.



Unit No. 17-A—Control Unit.



Unit No. 15-A—Oil increased 100%.

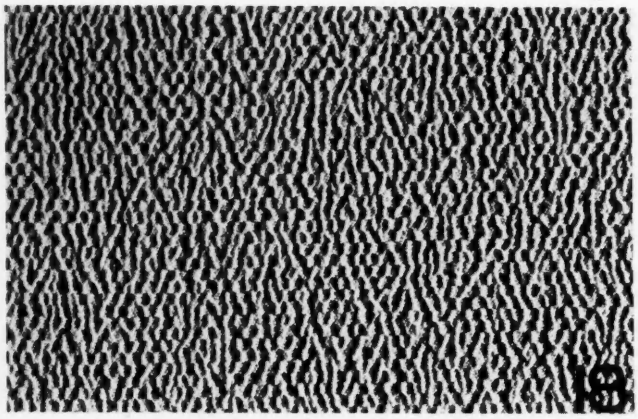
It was the purpose of this group to determine the effects of variations in the ratio of sulfonated olive oil to cocoanut oil used in the filling soaking bath. To find the effects of different variations four units of filling yarn were soaked, thrown, woven into fabric, dyed and finished. The only differences between these units were the ratio of sulfonated olive oil to cocoanut oil used in the filling soaking bath.

The units were identified as follows:

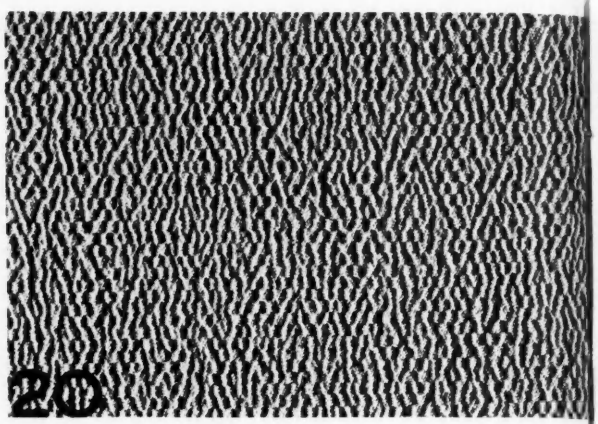
Unit No. 18—100% sulfonated olive oil

PLATE E

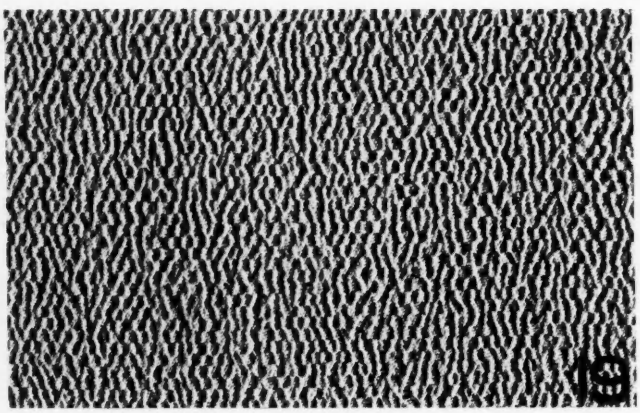
The Effects of Variations in the Ratio of Sulfonated Olive Oil to Cocoanut Oil in the Filling Soaking Bath



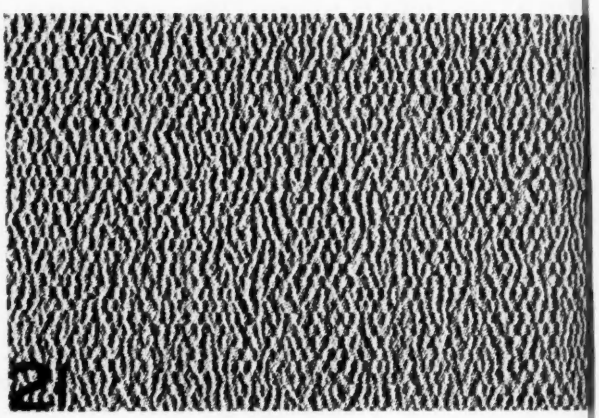
Unit No. 18—100% Sulfonated Olive Oil.



Unit No. 20—Control Unit—50% Sulfonated Olive Oil, 50% Cocoanut Oil.



Unit No. 19—75% Sulfonated Olive Oil, 25% Cocoanut Oil.



Unit No. 21—25% Sulfonated Olive Oil, 75% Cocoanut O

Unit No. 19— 75% sulfonated olive oil and 25% cocoanut oil
Control Unit No. 20— 50% sulfonated olive oil and 50% cocoanut oil
Unit No. 21— 25% sulfonated olive oil and 75% cocoanut oil

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the following ingredients and proportions:

Unit No. 18—*"S" and "Z" Twist Yarn*

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of sulfonated olive oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

Unit No. 19—*"S" and "Z" Twist Yarn*

1¼ lbs. of gelatin
1¼ lbs. of dextrine
13.5 lbs. of sulfonated olive oil
4.5 lbs. of cocoanut oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

Control Unit No. 20—*"S" and "Z" Twist Yarn*

1¼ lbs. of gelatin
1¼ lbs. of dextrine
9 lbs. of sulfonated olive oil
9 lbs. of cocoanut oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

Unit No. 21—*"S" and "Z" Twist Yarn*

1¼ lbs. of gelatin
1¼ lbs. of dextrine

4.5 lbs. of sulfonated olive oil
13.5 lbs. of cocoanut oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

The same type gelatin and dextrine was used in all of these formulae, their characteristics being the same as those used in Group "A." The oils used for Units No. 19, No. 20 and No. 21 were mixed in the proper proportions by the research fellow. The oils prepared emulsified readily and the soaking baths seems quite stable except in Unit No. 21 in which the oils appeared to come out of solution to some extent and rise to the surface of the soaking bath.

The oils before mixing had the following characteristics:

Sulfonated Olive Oil		*Cocoanut Oil*	
Moisture	30%	Moisture	Nil
Organic SO_3	8%	Free fatty acid....	5%
Free fatty acid...13-14%		Saponification	
Ash	9%	value 255-260	
Unsaponifiable ...	Nil		

Filling Soaking Procedure

The filling soaking procedure was exactly the same as Group "A."

Extraction

Each unit was extracted individually but they were all extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

		Gain over the original weights
	Unit No. 18—"S" Twist Yarn.....	88%
	"Z" Twist Yarn.....	83
	Unit No. 19—"S" Twist Yarn.....	94
	"Z" Twist Yarn.....	94
Control	Unit No. 20—"S" Twist Yarn.....	88
	"Z" Twist Yarn.....	88
	Unit No. 21—"S" Twist Yarn.....	94
	"Z" Twist Yarn.....	91

The extracted skeins were gently shaken out manually and were hung on the poles of drier trucks.

Drying, Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing

All of the units in this group were processed in the same manner in the drying, winding, twisting, twist setting, redrawing, copping, weaving, dyeing and finishing operations. (Refer to Group "A" for complete details of these operations.)

Evaluation of the Pebble of the Finished Fabrics in Group E

The ratio of sulfonated olive oil to cocoanut oil in the filling soaking bath had an important influence upon the pebble of the finished fabric. The most marked change in pebble occurred when more sulfonated olive oil was used than cocoanut oil. When more cocoanut oil was used than sulfonated olive oil the pebble decreased slightly.

The finished fabric in Unit No. 21 which contained the filling yarn which had been soaked in the bath with the high cocoanut oil content appeared much darker than the other units in this group, although they were all dyed in the same beck at the same time. This condition was apparently caused by the presence of cocoanut oil which had not been removed in the boil-off, or dyeing processes and which still remained on the yarn in residual form. It should be noted that this yarn was soaked in the bath in which there was a tendency for the cocoanut oil and olive oils to separate.

The photographs in Plate E show the pebble of the finished fabrics in this group, the trend and differences between the units.

GROUP F

THE EFFECTS OF VARIATIONS IN THE pH OF THE FILLING SOAKING BATH

During the past few years the pH of the soaking baths in throwing plants has been commanding the attention of progressive manufacturers. Although most of the commercial research on this subject has been devoted to the soaking of silk hosiery yarn, much interest has also been shown in the pH of baths used in soaking rayon yarn for crepe purposes.

In this investigation nine units of rayon filling yarn were soaked in baths of different pH values, thrown, woven into fabric, dyed and finished. The same quantity of base ingredients were used in each bath but sodium carbonate or sulfuric acid was added to the individual bath to adjust the pH value. The units were all processed alike in all the other processes throughout the throwing, weaving, dyeing and finishing plants.

The units in this group were identified as follows:

	Unit No. 22 —pH 3.5
	Unit No. 23 —pH 4.5
Control	Unit No. 24 —pH 5.5
	Unit No. 25 —pH 6.5
	Unit No. 26 —pH 7.5
	Unit No. 27 —pH 8.5
	Unit No. 28 —pH 9.5
	Unit No. 29 —pH 10.5
	Unit No. 29A—pH 10.0

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the same amount of ingredients and proportions.

The base ingredients used in each bath were as follows:

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

The amount of acid or alkali used in the individual units to obtain the desired pH was as follows:

Unit No.	*pH*	*Sulfuric Acid*	*Potassium Carbonate*
22	3.5	990 CC	
23	4.5	632	
24	5.5	None	
25	6.5		104 CC
26	7.5		385
27	8.5		605
28	9.5		990
29	10.5		2200
29A	10.0		2200

NOTE: It was found in trying to reach a pH of 10.5 that predetermined amounts of alkali would not raise the pH up to 10.5 and in some instances the addition of double the predetermined amount of alkali would not raise the pH to 10.5. An investigation was made of some of the possible causes of this phenomena. It was soon observed that the type of tint in the bath influenced the pH value. Several baths were prepared having different tints and it was found that only certain tints interfered with the pH value. Since it was desired to get a pH value of 10.5 two baths were prepared containing tints which did not interfere with the pH when the alkali was added and then two other baths were prepared containing tints which interfered with the pH value, when the alkali was added. The same amount of alkali was added in both instances and in the first two baths the resultant pH was 10.5 and in the second bath the pH was 10.0. Since the two units had the same amount of alkali added yet had different pH values it was of interest to find out whether these differences would affect the pebble of the finished fabric in any way so the two groups of baths were used to soak different units. The baths having a pH of 10.5 were used to soak Unit No. 29 and the baths having a pH of 10.0 were used to soak Unit No. 29A.

Unit No. 29A—"S" and "Z" Twist Yarn

The same base ingredients and proportions were used as in Unit No. 22 except that 2,200 c.c. of a concentrated solution of potassium carbonate solution was added to bring the pH up to 10.

The same base ingredients were used in all of the baths. Their characteristics were the same as those used in soaking the filling in Group "A".

Filling Soaking Procedure

The same procedure was used to prepare the baths and soak all of the units in this group. The procedure was as follows:

The baths were started by running water into the tubs until about half the volume was reached. The gelatin and dextrine was then steeped in a separate container for a few minutes in cold water, gently stirred, then heated to 140° F. and stirred until fully dissolved. The solution was then poured through a filter into the bath. The oil was then poured into the bath through the filter and the tint which was previously dissolved in water was filtered and added to the bath. Sufficient water and the pre-determined amount of acid or alkali was then added until the total volume was reached. The temperature was then raised to 125° F. and the baths thoroughly stirred with an electric propeller stirrer. Test specimens of the baths were then taken and tested on a Thwing-Albert pH tester (potentiometeric type No. 7749).

The skeins were then submerged in the baths for thirty minutes. They were then removed, allowed to drain three minutes and extracted.

Extraction

Each unit was extracted individually but all were extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

		Gain over the original weights
Unit No. 22	—"S" Twist Yarn.....	88%
	"Z" Twist Yarn.....	85
Unit No. 23	—"S" Twist Yarn.....	83
	"Z" Twist Yarn.....	83
Control Unit No. 24	—"S" Twist Yarn.....	83
	"Z" Twist Yarn.....	85
Unit No. 25	—"S" Twist Yarn.....	88
	"Z" Twist Yarn.....	85
Unit No. 26	—"S" Twist Yarn.....	91
	"Z" Twist Yarn.....	88
Unit No. 27	—"S" Twist Yarn.....	85
	"Z" Twist Yarn.....	88
Unit No. 28	—"S" Twist Yarn.....	85
	"Z" Twist Yarn.....	88
Unit No. 29	—"S" Twist Yarn.....	94
	"Z" Twist Yarn.....	91
Unit No. 29A	—"S" Twist Yarn.....	85
	"Z" Twist Yarn.....	88

The extracted skeins were gently shaken out manually and hung on the poles of drier trucks.

Drying, Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing

The units in this group were all processed in the same manner in the drying, winding, twisting, twist setting, redrawing, copping, weaving, dyeing and finishing operations (refer to Group "A" for complete details of these operations).

The Evaluation of the Pebble of the Finished Fabrics in Group F

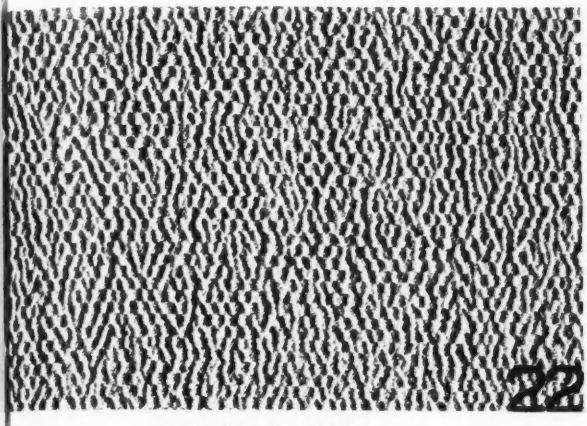
The pebble of the finished fabric varied with the pH of the filling soaking bath. The lowest pebble was obtained when the filling yarn was soaked in nearly neutral baths (Unit No. 25 and Unit No. 26).

From the neutral point toward the acid side (pH 7.5 to 3.5) there was a marked increase in pebble as the acidity of the bath was increased. The highest pebble in this group was obtained by soaking the filling yarn in the most acid bath (Unit No. 22, pH 3.5).

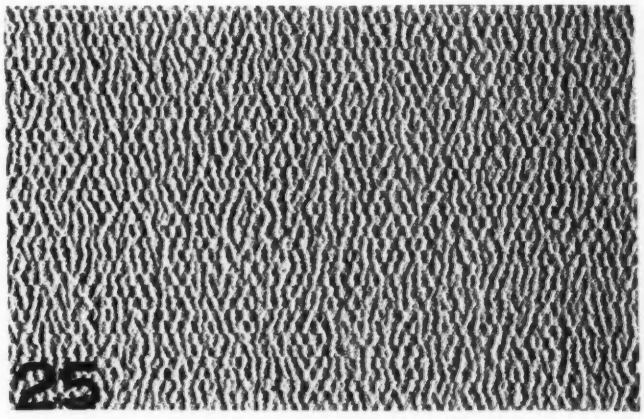
When the soaking bath was made slightly alkaline a sharp increase in pebble was also obtained (Unit No. 27,

PLATE F

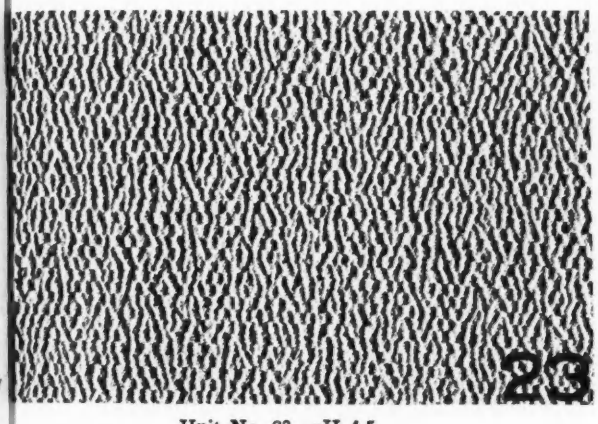
The Effects of Variations in the pH of the Filling Soaking Bath



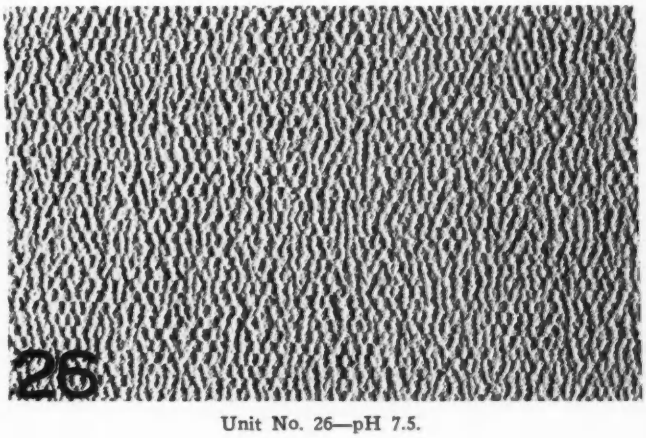
Unit No. 22—pH 3.5.



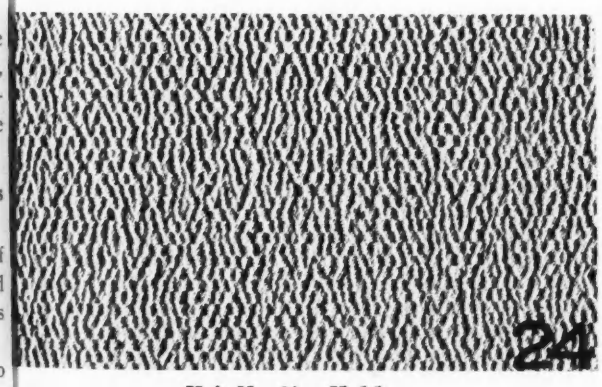
Unit No. 25—pH 6.5.



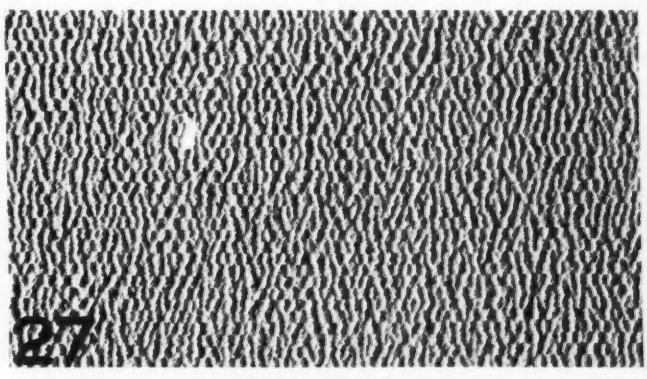
Unit No. 23—pH 4.5.



Unit No. 26—pH 7.5.



Unit No. 24—pH 5.5.

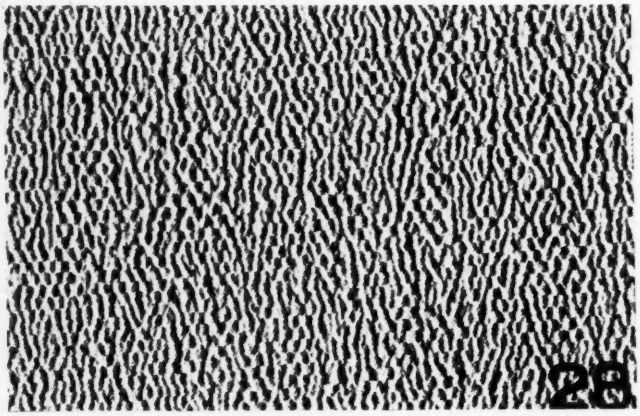


Unit No. 27—pH 8.5.

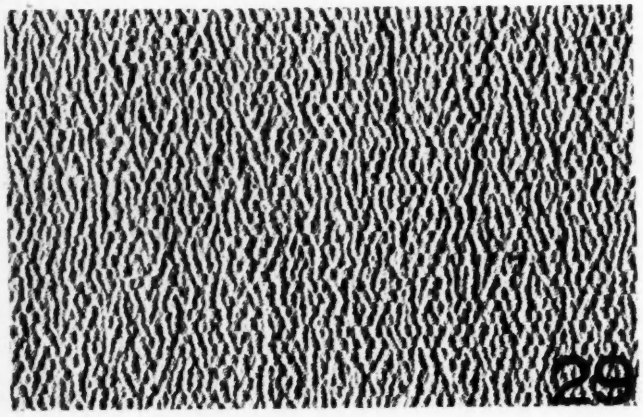
pH 8.5) but beyond this point the pebble did not increase with further increase in alkalinity (Units Nos. 28, 29, 29A). These results while clearly visible in the fabrics made were unexpected and the Committee feels that they should not be taken as final without further confirmation. The photographs in Plate F shows the differences in pebble obtained by varying the pH of the filling soaking baths.

PLATE F Contd.

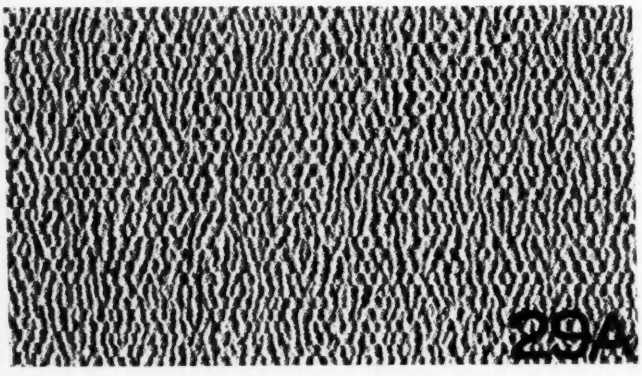
The Effects of Variations in the pH of the Filling Soaking Bath



Unit No. 28—pH 9.5.



Unit No. 29—pH 10.5.



Unit No. 29-A—pH 10.0.

GROUP G

THE EFFECTS OF VARIATIONS IN THE EXTRACTION OF THE FILLING YARN AFTER SOAKING

Five units of filling yarn were soaked, thrown, woven into fabric, dyed and finished to determine (1) the effects of direct variations in the extraction of the skeins of filling yarn after soaking and (2) to find the effects of jointly varying the quantity of ingredients in the soaking bath and the extraction time.

The five units in this group were identified as follows:

Unit No. 30—Control Unit.
Unit No. 31—Extraction time decreased.
Unit No. 32—Extraction time increased.
Unit No. 33—Quantity of ingredients of the soaking bath increased and extraction time increased.
Unit No. 34—Quantity of ingredients of the soaking bath decreased and extraction time decreased.

Preparation of the Warp Yarn

The warp yarn and the preparation of the warp in this group were the same as in Group A. (Refer to Group A for complete details.)

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, one for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The units were soaked in baths containing the following ingredients and proportions:

Control Unit No. 30—"S" and "Z" Twist Yarn

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

Units No. 31 and No. 32 were soaked the same as Unit No. 30.

Unit No. 33—"S" and "Z" Twist Yarn

2 lbs. of gelatin
2 lbs. of dextrine
28.8 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

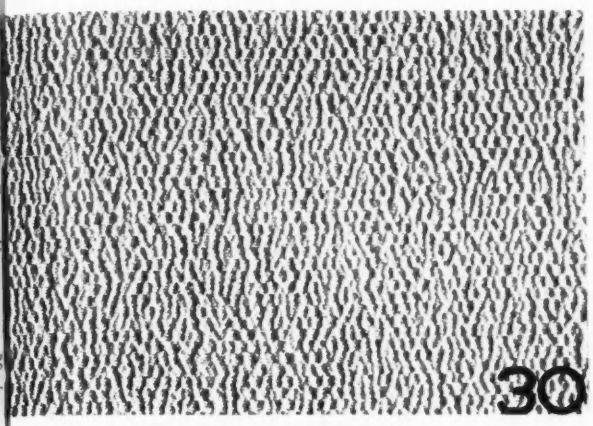
Unit No. 34—"S" and "Z" Twist Yarn

.87 lbs. of gelatin
.87 lbs. of dextrine
12.6 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

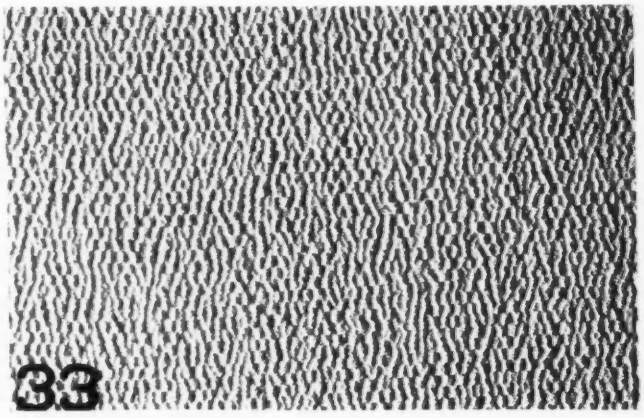
The ingredients used in soaking these units were the same as in Group A. (Refer to Group A for the details of their characteristics.)

PLATE G

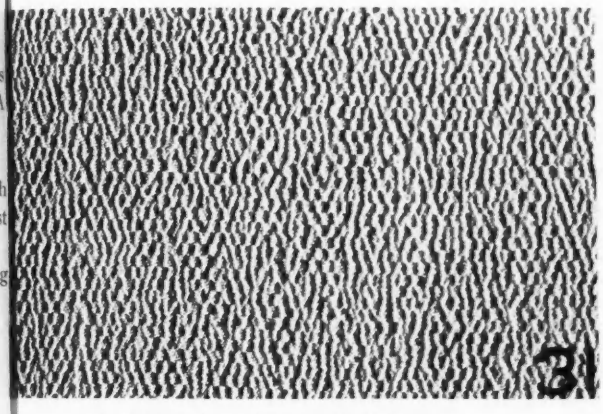
The Effects of Variations in the Extraction of the Filling Yarn After Soaking



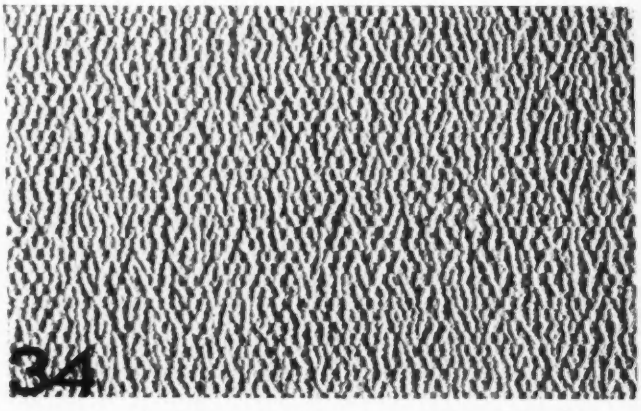
Unit No. 30—Control Unit.



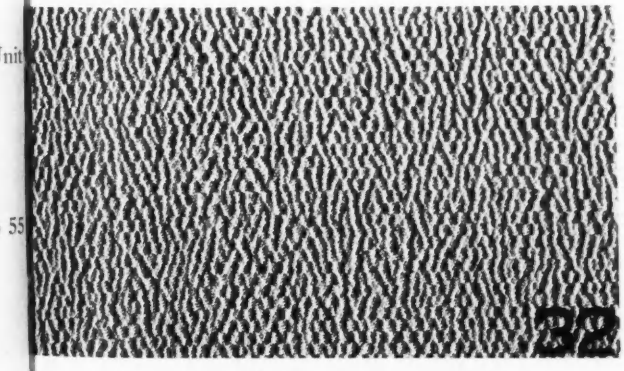
Unit No. 33—Quantity of ingredients of the soaking bath increased and extraction time increased.



Unit No. 31—Extraction time decreased.



Unit No. 34—Quantity of ingredients of the soaking bath decreased and extraction time decreased.



Unit No. 32—Extraction time increased.

Filling Soaking Procedure

The procedure used in soaking all of the units in this group was the same and corresponded with the method used in soaking the units in Group A.

Extraction

Each unit was extracted individually and the extraction time was different for each unit. The extracted weights exceeded the original weights by the following amounts:

		Gain over the original weights
Control	Unit No. 30—"S" Twist Yarn.....	91%
	"Z" Twist Yarn.....	91
	Unit No. 32—"S" Twist Yarn.....	130
	"Z" Twist Yarn.....	130
	Unit No. 32—"S" Twist Yarn.....	80
	"Z" Twist Yarn.....	82
	Unit No. 33—"S" Twist Yarn.....	82
	"Z" Twist Yarn.....	82
	Unit No. 34—"S" Twist Yarn.....	106
	"Z" Twist Yarn.....	103

Drying, Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing

All of the units in this group were processed in the same manner in the drying, winding, twisting, twist

setting, redrawing, copping, weaving, dyeing and finishing operations. (Refer to Group A for complete details of these operations.)

Evaluation of the Pebble of the Finished Fabrics in Group G

Variations in the extraction of the skeins of filling after soaking had no appreciable effect upon the pebble of the finished fabric (Units Nos. 30, 31, 32).

Some slight differences were visible however in Units No. 33 and No. 34 in which the ingredients in the soaking bath were varied as well as the extraction time. As shown in Plate G, Unit No. 33 had a slightly lower pebble than Control Unit No. 30, and Unit No. 34 had a slightly higher pebble. The differences corresponded somewhat to the differences obtained by varying the quantity of ingredients in the bath in Group A. When the ingredients in the bath were increased the pebble was reduced and when the ingredients in the bath were decreased the pebble increased slightly. It is apparent that the pebble was not greatly affected in these units (No. 33 and No. 34) by varying the extraction time because they followed the same trend as the units in Group A in which the ingredients were varied and the extraction time was kept constant.

GROUP H
THE EFFECTS OF VARIATIONS IN FILLING SKEIN DRYING AFTER SOAKING

At the time that this investigation was being carried on there was some disagreement among technicians regarding the best temperature to use in drying rayon. A research program on drying was being conducted by the U. S. Institute for Textile Research but no facts on the subject were available.

The temperature used most extensively in throwing plants to dry rayon skeins after soaking is approximately 180° F., whereas many technicians recommend 135° F. It has been previously stated that because of the absence of facts on this subject the arbitrary temperature of 150° F. was chosen as the base or control drying temperature for this research. The moisture content of the dry skeins was also considered. In all but this group the drying time was regulated so that at no time were the skeins permitted to dry to less than 5 per cent moisture content.

In this investigation three units were dried in different ways to determine the effects of variations in skein drying upon the pebble of the finished fabric. The effects of variations in drying upon the physical and chemical properties of the yarn were not considered.

Three units of filling yarn were soaked in the same way, dried in different ways and then were thrown, woven into fabric, dyed and finished in the same way.

The units were identified as follows:

Unit No. 35—Filling skeins air dried at room temperature

Control Unit No. 36—Filling skeins dried at 150° F. to 5.5 per cent moisture content

Unit No. 37—Filling skeins dried at 200° F. to 1.0 per cent moisture content

Preparation of the Warp Yarn

The warp yarn and preparation of the warp in this group were the same as in Group A. (Refer to Group A for complete details.)

Preparation of the Filling Yarn

Two baths were used to soak the filling yarn in each unit, for the "S" twist yarn and one for the "Z" twist yarn, but they were both treated the same.

The three units in this group were soaked in exactly the same way. The baths used contained the following ingredients and proportions.

Units Nos. 35, 36, 37—"S" and "Z" Twist Yarns

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

The ingredients used in soaking these units were the same as in Group A. (Refer to Group A for the details of their characteristics.)

Filling Soaking Procedure

The filling soaking procedure was exactly the same as Group A.

Extraction

The units in this group were extracted the same length of time.

The extracted weight exceeded the original weights by the following amounts:

	Gain over the original weights
Unit No. 35—"S" Twist Yarn	92%
"Z" Twist Yarn	91
Unit No. 36—"S" Twist Yarn	91
"Z" Twist Yarn	88
Unit No. 37—"S" Twist Yarn	88
"Z" Twist Yarn	88

The extracted skeins were shaken out gently and hung on the poles of drier rtucks.

Drying

The wet skeins constituting Unit No. 35 were not placed in the drying oven but were placed in an unhumidified room for five days.

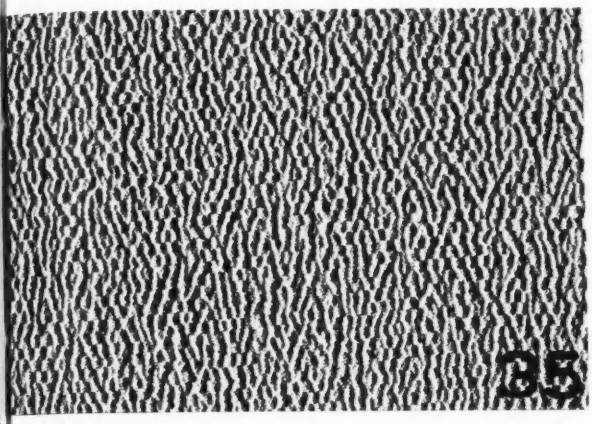
The skeins in Unit No. 36 were placed in the drying oven for about three hours during which time the oven was maintained at 150° F. ± 5.° F. Upon removal the skeins contained 5.5 per cent moisture.

The skeins in Unit No. 37 were placed in the drying oven for two hours during which time the oven was maintained at 200° F. ± 5.° F. Upon removal the skeins contained 1 per cent moisture.

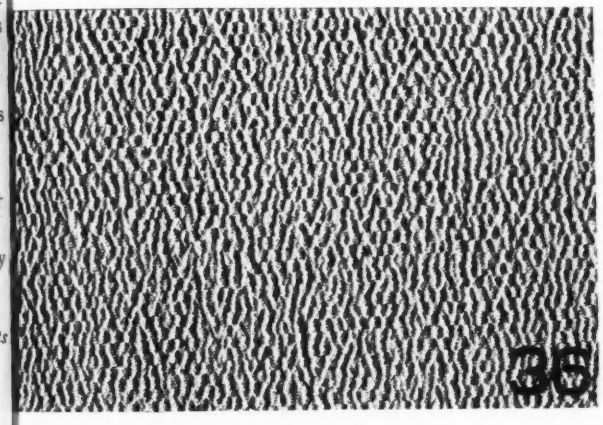
Before winding, the skeins in all the units were placed in the humidified winding room for two days to allow them

PLATE H

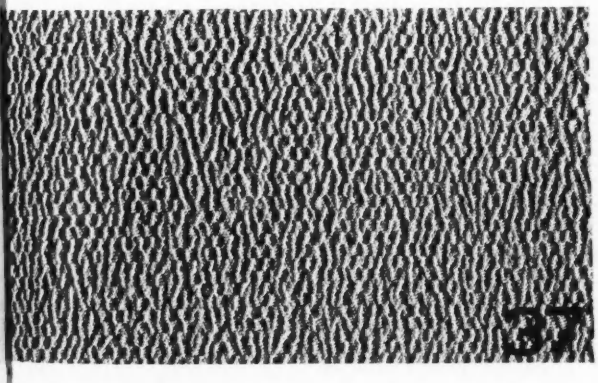
he Effects of Variations in Filling Skein Drying After Soaking



nit No. 35—Filling skeins air dryed at room temperature.



nit No. 36—Filling skeins dryed at 150° F. to 5.5% moisture content.



nit No. 37—Filling skeins dryed at 200° F. to 1.0% moisture content.

to come to equilibrium with the atmosphere in which they were wound.

Winding, Twisting, Twist Setting, Redrawing, Copping, Weaving, Dyeing and Finishing

The units in this group were all processed in the same manner in the winding, twisting, twist setting, redrawing, copping, weaving, dyeing and finishing operations. (Refer to Group A for the complete details of these operations.)

The Evaluation of the Pebble of the Finished Fabrics in Group H

There were no appreciable differences in the pebble of the finished fabric in this group. Although upon close scrutiny the photographs of the finished fabric in Plate H show that the pebble in Unit No. 35 was slightly higher than No. 36 and No. 37. The major differences between these units were in the color of the finished fabric. Unit No. 36 was slightly lighter than No. 35, and No. 37 was much lighter in color than Unit No. 35 and No. 36, although they were dyed in the same bath.

It can be concluded from this investigation that the pebble of the finished fabric is not greatly affected by variations in the drying of the filling skeins but that the yarn's affinity for dyestuff is appreciably reduced by high temperatures.

GROUP I

THE EFFECTS OF VARIATIONS IN THE TENSION ON THE WARP AND FILLING YARNS IN THROWING AND WEAVING PLANTS

The amount of tension or strain on rayon yarn during the manufacture of rayon crepe fabric has always been the subject of much interest. In Part No. 1 of this report the data presented showed the amount of tension used on 200 denier filling yarn in throwing and weaving plants and the variations existing in each process. It was the purpose of this part of the investigation to determine whether the variations in average plants had any effect upon the pebble of the finished fabric.

Fifteen units were processed in this group using the minimum, average and maximum tensions found in commercial plants. The tensions were varied on the filling yarn in the winding, twisting, redrawing and copping operations and on the warp during weaving.

All of the units in this group were processed in an atmosphere of 50 per cent to 60 per cent relative humidity and no investigation was made at this time of the effects of different humidities in relation to the variations in tension. It has been previously mentioned that it was only possible to investigate the effects of tension only on 150 denier warp yarn and 200 denier filling yarn within the scope of this research, therefore, the results only apply to these yarns and the methods used in their processing.

The units in this group were identified as follows:

	Average Tension Unit No.	*Low Tension Unit No.*	*High Tension Unit No.*
Winding operation	38	39	40
Twisting operation	41	42	43

Redrawing operation	44	45	46
Copping operation	47	48	49
Weaving operation	50	51	52

In order to determine the effects of variations in the individual operations each unit in this group was processed in the same manner as the control unit in all of the operations except the one in which some special tension was applied. In other words, only one change was made in each unit and all the other factors were kept constant.

Preparation of the Filling Yarn

As in all of this investigation 200 denier filling yarn was used in this group.

To preclude the possibility of introducing even the slightest alien influence, all of the filling units in this group were soaked in the same baths, that is, the "S" twist yarn in one bath and the "Z" twist yarn in another. The two filling soaking baths contained the same ingredients and proportions as those used to soak all of the control units in this investigation. They contained the following ingredients and proportions:

1¼ lbs. of gelatin
1¼ lbs. of dextrine
18 lbs. of oil
Soft water to bring the total volume of the bath to 55 gallons
110 lbs. of yarn

The ingredients had the same characteristics as those used in Group "A" and the same method was used in the preparation of the baths.

Extraction

All of the "S" and "Z" twist yarn comprising this group was extracted the same length of time. The extracted weights exceeded the original weights by the following amounts:

	Gain over the original weights
"S" Twist Yarn.....	90%
"Z" Twist Yarn.....	88%

The extracted skeins were gently shaken out manually and hung on the poles of the drier trucks.

Drying

All of the yarn in this group was placed in the drying oven at the same time and was allowed to remain in the oven about three hours. The temperature of the oven was maintained at 150° F. ± 5° F. Moisture tests showed that there was 6.0 per cent moisture left in the yarn after drying. Upon its removal the yarn was placed in the conditioned winding room for 48 hours before it was wound to give it an opportunity to come to equilibrium with the atmosphere in which it was wound.

Winding

At this point Units No. 39 and No. 40 were segregated from the other units. Unit No. 39 was wound with low tension and No. 40 was wound with high tension, while the other units were treated as one unit and wound with average tension. All of the units were wound at the same time under the same general conditions. The methods used were the same except that 6 ounce weights were used on the swift axles in winding Unit No. 39, 36 ounce weights were used on the swifts in winding No. 40 and 12 ounce weights were used on the swift axle in winding all of the other units.

Atmospheric conditions (aver.).. Temperature 80° F.
Relative humidity 55%

Tension or Strain on the Yarn During Winding
(All units except No. 39 and No. 40)

Range Tension (Grams)	*Per Cent of Ends*
21 to 25.....	.4
26 to 30.....	9.3
31 to 35.....	42.6
36 to 40.....	37.0
41 to 45.....	8.9
46 to 50.....	1.8
	100.0
Unit No. 39—16 to 20.....	50.0
21 to 25.....	50.0
	100.0
Unit No. 40—56 to 60.....	12.5
61 to 65.....	37.5
66 to 70.....	50.0
	100.0

Units No. 39 and No. 40 were processed in an average manner or the same as the control units in all of the subsequent operations.

Twisting or Throwing

The methods used in twisting all of the units were the same except that light flyers were used in twisting Unit No. 42 and heavy flyers were used in twisting Unit No. 43.

Flyers Used

Make—McHale.
Type—4 arm, mill nut.
Weight—Unit No. 42—No. 7 wire.
Unit No. 43—No. 16 wire.
Units No. 38, 39, 40, 41, 44, 45, 46, 47, 48, 49, 50, 51, 52—No. 10 wire.
Atmospheric conditions (aver.).. Temperature 84° F.
Relative humidity 52%

Tension or Strain on the Yarn During Twisting
(All units except Units No. 42 and No. 43)

Range Tension (Grams)	*Per Cent of Ends*
11 to 15.....	26.1
16 to 20.....	37.5
21 to 25.....	23.0
26 to 30.....	11.4
31 to 35.....	2.0
	100.0

Unit No. 42—11 to 15		54.2
	16 to 20	33.3
	21 to 25	12.5
		100.0
Unit No. 43—26 to 30		16.7
	31 to 35	29.1
	36 to 40	25.0
	41 to 45	25.0
	46 to 50	4.2
		100.0

Units No. 42 and No. 43 were processed in an average manner or the same as the control units in all of the subsequent operations.

Twist Setting or Steaming

To set the twist all of the 15 units in this group were placed in a Lydon steam box at the same time. The box was maintained at 180° F. dry bulb and 175° F. wet bulb (89 per cent relative humidity) and the yarn was allowed to remain in the box continuously for 3½ hours under these conditions. The yarn was then removed and placed in the humidified redrawing room for 12 hours before redrawing.

Redrawing

The method used in redrawing all the units in this group was the same except that light tension was used on Unit No. 45 and heavy tension was used in redrawing No. 46.

Atmospheric conditions (aver.).. Temperature 86.0° F.
Relative humidity 57%

Tension or Strain on the Yarn During Redrawing
(All units except Units No. 45 and No. 46)

Range Tension (Grams)	*Per Cent of Ends*
16 to 20	1.1
21 to 25	22.1
26 to 30	42.5
31 to 35	20.3
36 to 40	11.1
41 to 45	2.5
46 to 50	.4
	100.0

Unit No. 45—16 to 20		59.0
	21 to 25	41.0
		100.0
Unit No. 46—41 to 45		12.5
	46 to 50	12.5
	51 to 55	43.5
	56 to 60	19.0
	61 to 65	12.5
		100.0

After redrawing, all of the units were wrapped, packed into cases and shipped to the weaving plant.

Units No. 45 and No. 46 were processed the same as the control units in all of the subsequent operations.

Copping

All of the units in this group were copped in the same manner except that Unit No. 48 was copped with low tension and Unit No. 49 with high tension.

Atmospheric conditions (aver.).. Temperature 78° F.
Relative humidity 50%

Tension or Strain on the Yarn During Copping
(All the units except No. 48 and No. 49)

Range Tension (Grams)	*Per Cent of Ends*
46 to 50	.4
51 to 55	1.3
56 to 60	13.8
61 to 65	50.0
66 to 70	29.6
71 to 75	4.9
	100.0

Unit No. 48—36 to 40		6.3
	41 to 45	31.2
	46 to 50	62.5
		100.0
Unit No. 49—76 to 80		58.3
	81 to 85	16.7
	86 to 90	25.0
		100.0

Weaving

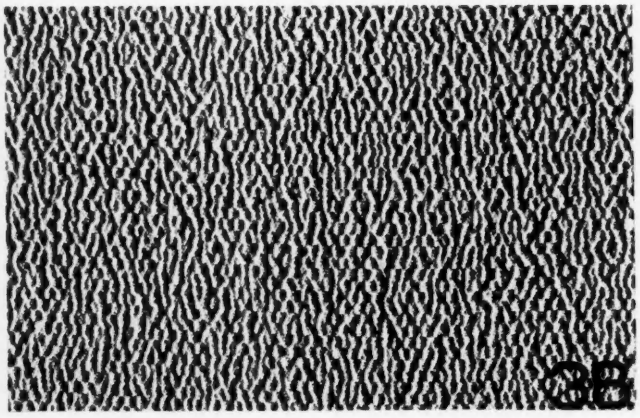
Units No. 38, 39, 40; 41, 42, 43; 44, 45, 46; and 47, 48, 49; were all woven in the same way. The specifications used in weaving were the same as in Group "A."

To determine the effects of variations in tension on the warp during weaving, one portion of the warp was woven with average tension (Unit No. 50), a second portion was woven with low tension (Unit No 51) and a third portion with high tension (Unit No. 52). As in the throwing and copping operations the tension on the filling yarn during the weaving of these three units was kept constant.

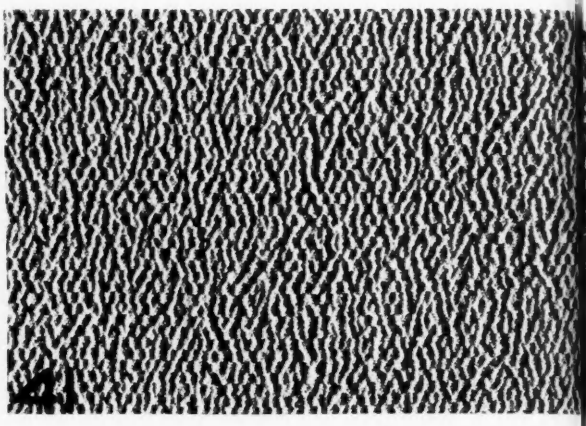
The tension on the warp was recorded by a Crompton & Knowles warp tension meter. Since no standards were available on the looms used, the average tension (Unit No. 50) was determined by the personal judgment of the research fellow in cooperation with the weave room staff. This tension had been used in weaving the fabric in Part No. 4 of this research and the numerous units woven previously in this part. To determine the minimum tension for Unit No. 51 the tension was released as much as possible without interfering with the running of the loom. The maximum tension (Unit No. 52) was determined by tightening up the warp until the ends began to break and then releasing the tension slightly until the ends stopped breaking. The three respective points were recorded on the tension meter and maintained during the weaving

PLATE I

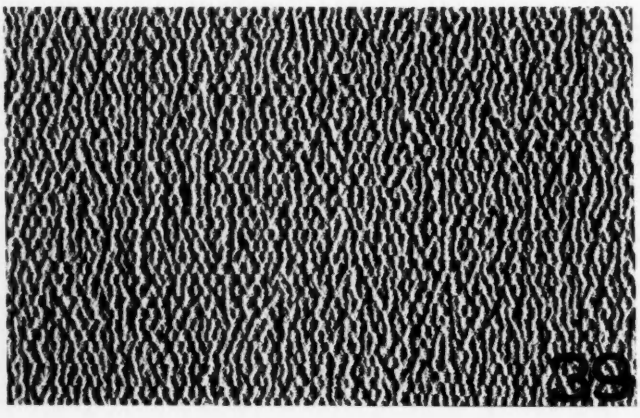
The Effects of Variations in the Tension on the Warp and Filling Yarns in Throwing and Weaving Plants



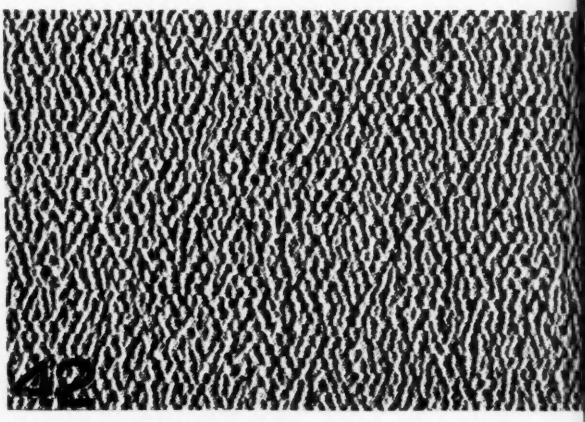
Unit No. 38—Average tension in winding.



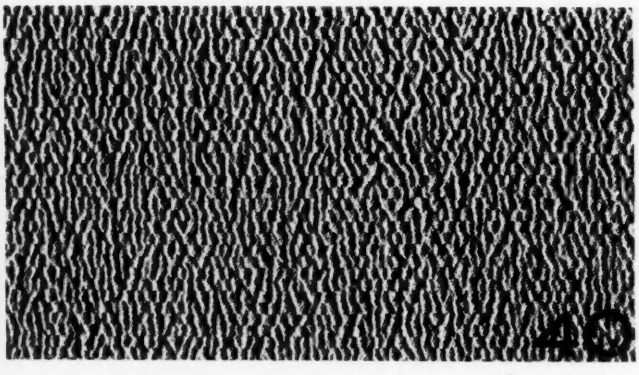
Unit No. 41—Average tension in twisting.



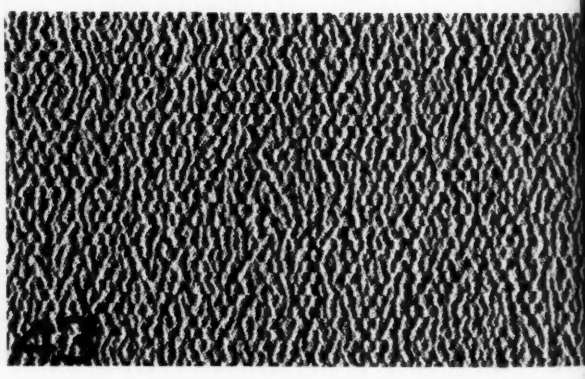
Unit No. 39—Low tension in winding.



Unit No. 42—Low tension in twisting.



Unit No. 40—High tension in winding.



Unit No. 43—High tension in twisting.

of the respective units. The tension used was as follows:

Unit No. 50—50 ends read 50 to 60 on the tension meter.

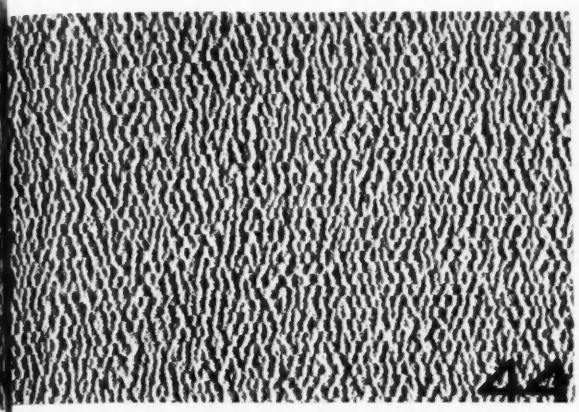
Unit No. 51—50 ends read 30 to 40 on the tension meter.

Unit No. 52—50 ends read 70 to 75 on the tension meter.

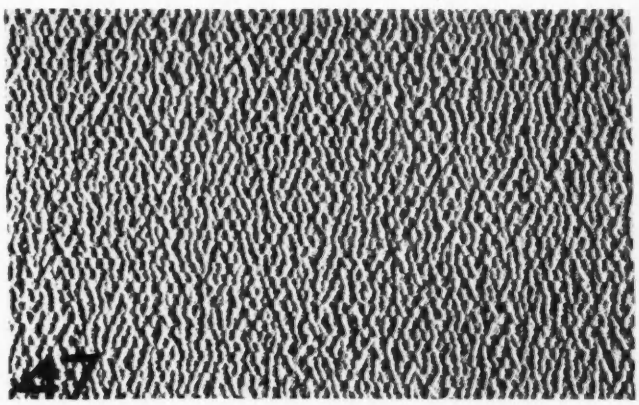
Atmospheric conditions (aver.).. Temperature 81° F.
Relative humidity 52%

PLATE I Contd.

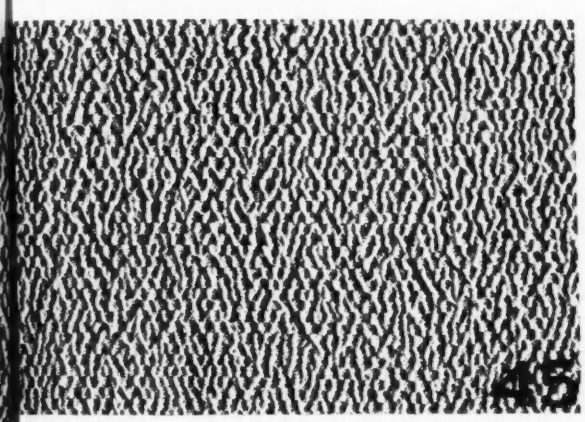
The Effects of Variations in the Tension on the Warp and Filling Yarns in Throwing and Weaving Plants



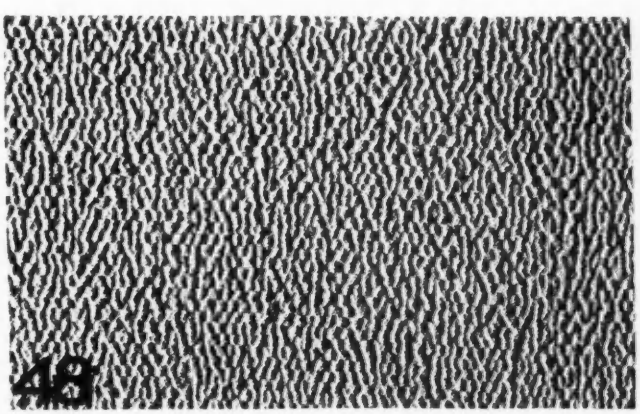
Unit No. 44—Average tension in redrawing.



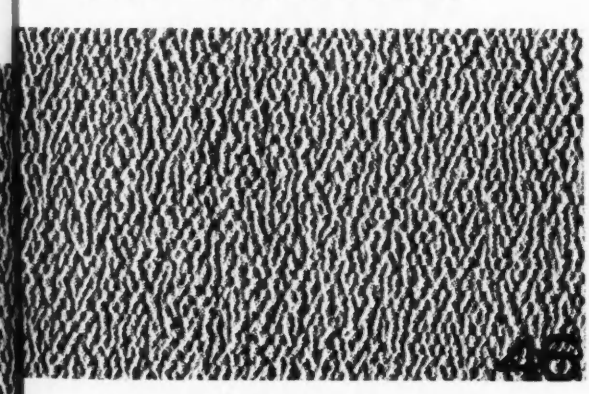
Unit No. 47—Average tension in copping.



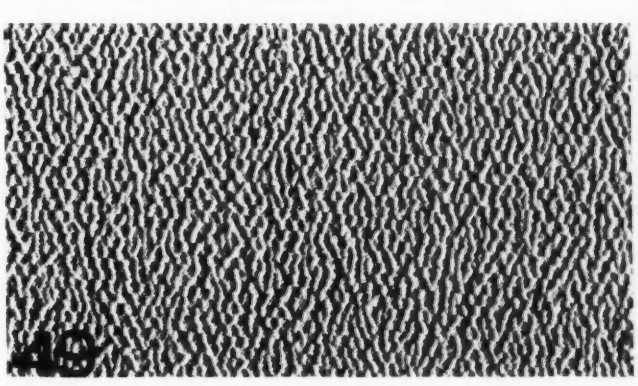
Unit No. 45—Low tension in redrawing.



Unit No. 48—Low tension in copping.



Unit No. 46—High tension in redrawing.



Unit No. 49—High tension in copping.

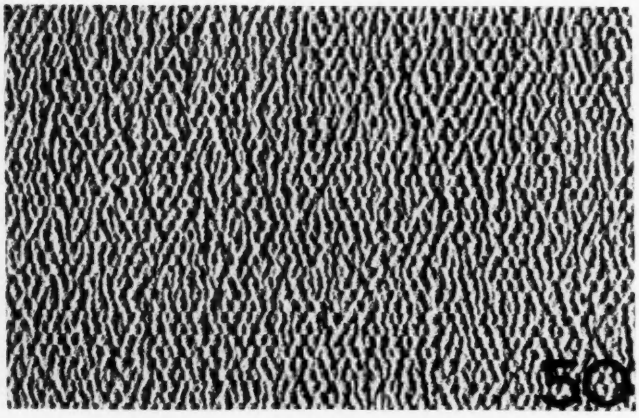
Evaluation of the Pebble of the Finished Fabrics in Group I

The only observable variation in the pebble of the finished fabric resulting from variations in the tension used on the yarn was produced by varying the tension in the redrawing operation but in view of the absence of pebble variation in the other steps involving similar tension variations the Committee feels that this one instance is of no significance.

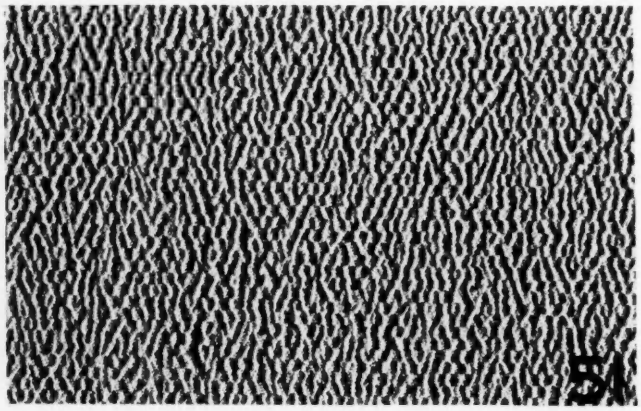
It can be concluded from this investigation that the

PLATE I Contd.

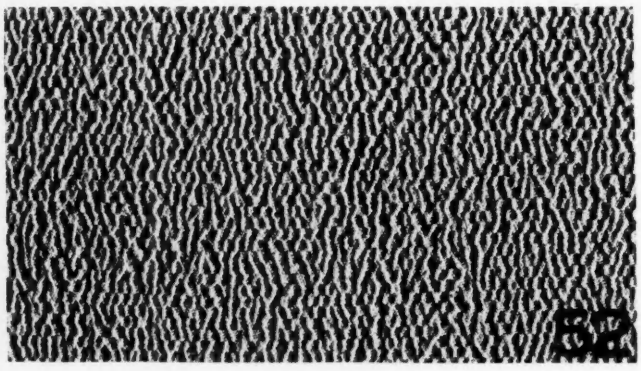
The Effects of Variations in the Tension on the Warp and Filling Yarns in Throwing and Weaving Plants



Unit No. 50—Average tension in weaving.



Unit No. 51—Low tension in weaving.



Unit No. 52—High tension in weaving.

variations in tension on 200 denier yarn in better controlled throwing and weaving plants has no appreciable influence upon the pebble of the finished fabric.

The photographs in Plate I show the fabric made in th group.

GROUP J

THE EFFECTS OF VARIATIONS IN TH TWIST SETTING OR STEAMING OPERATIO

It was the purpose of this investigation to determin the effects of variations in the twist setting or steamin operation upon the pebble of the finished fabric.

When rayon yarns are highly twisted they will untwis kink or tangle in the subsequent operations unless th tortional forces causing these tendencies are suppresse temporarily discharged or caused to lie dormant.

The most effective and practical means developed fo treating the yarn to prevent untwisting, kinking or tanglin is to saturate the twisted yarn with water vapor.

The requirements of a set crepe yarn are controversia but for the purpose of this research it was considered tha a properly set yarn reasonably resisted untwisting, kinkin or tangling in the subsequent operations. The amount o treatment necessary to cause the yarn to refrain fro untwisting depends on many factors among which are th denier of the yarn, twist per inch, size and type of take-u shafts, the type of steaming apparatus, the temperatur and relative humidity of the atmosphere in which the yar is exposed and the time of exposure.

In this investigation the only factors varied were th temperature and relative humidity of the atmosphere i which the yarn was exposed and the time of exposure All the other factors which might influence this operatio were kept constant.

Sufficient yarn for this investigation was soaked, woun and twisted as one unit and then divided into six units a the steaming or twist setting operation. Each of the si units was steamed individually in a Lydon electric stea box under the following conditions:

Unit No.	*Temperature*	*Relative Humidity*	*Time*
53 (Control)	180° F.	89%	3½ hour
54	140	75	3½ hour
55	180	89	7 hour
56	180	89	14 hour
57	205	92	3½ hour
58	198	70	3½ hour

The units were left in the box continuously for the lengt of time shown in the above table.

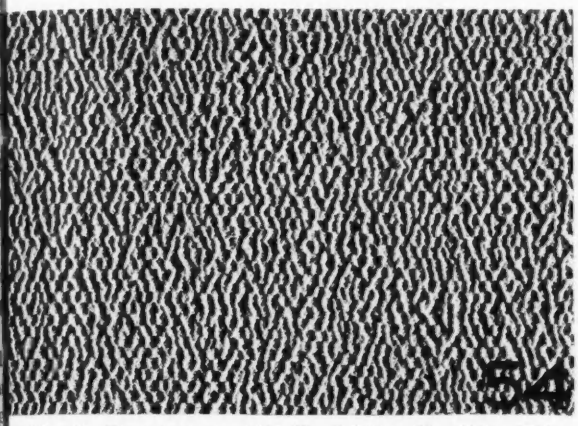
After steaming the untis were redrawn, copped, wove into fabrics, dyed and finished in the same manner.

Evaluation of the Pebble of the Finished Fabrics i Group J

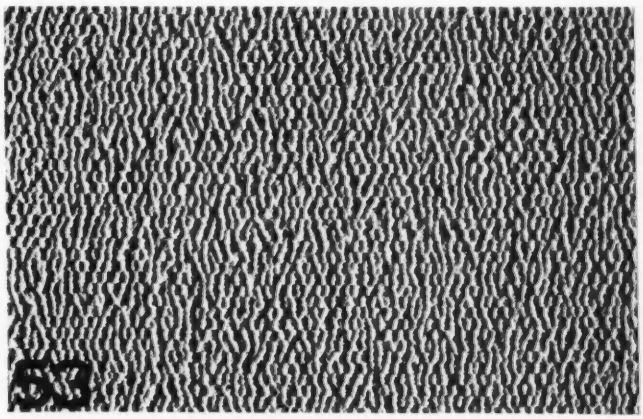
There were some slight differences in the pebble of th finished fabrics in this group. It can be concluded how ever the time of steaming (Units No. 53, 55, 56) had n effect upon the pebble. The greatest differences resulte from steaming at high temperature and high relative humidity (Unit No. 57). Variations in temperature alon had little effect (Units No. 54 and 58) upon the pebble

PLATE J

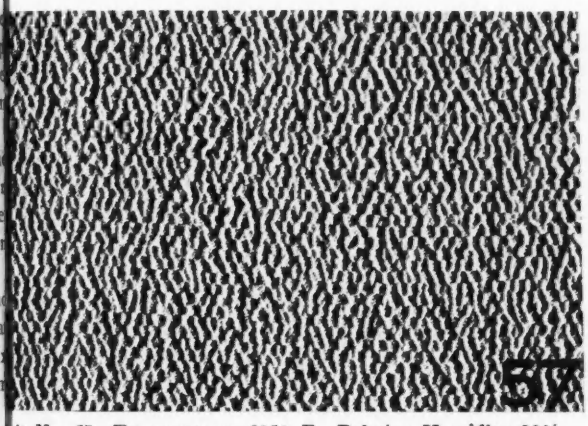
The Effects of Variations in the Twist Setting or Steaming Operation



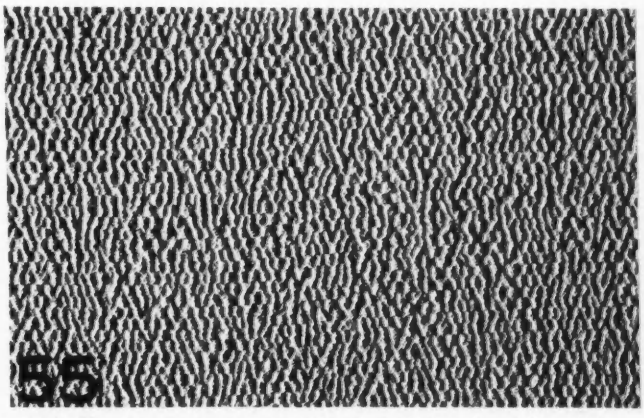
it No. 54—Temperature—140° F., Relative Humidity 75%, Time 3½ hours.



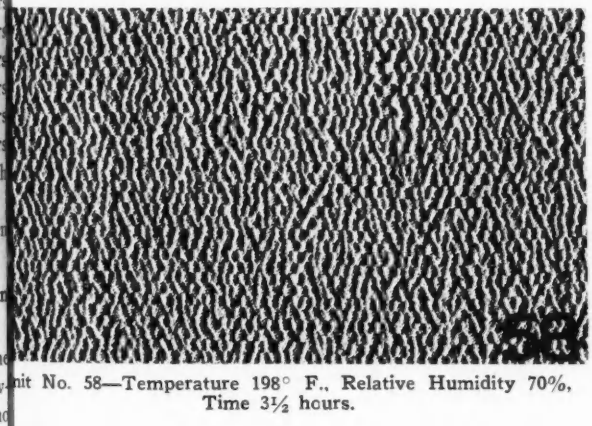
Unit No. 53 (Control)—Temperature 180° F., Relative Humidity 89%, Time 3½ hours.



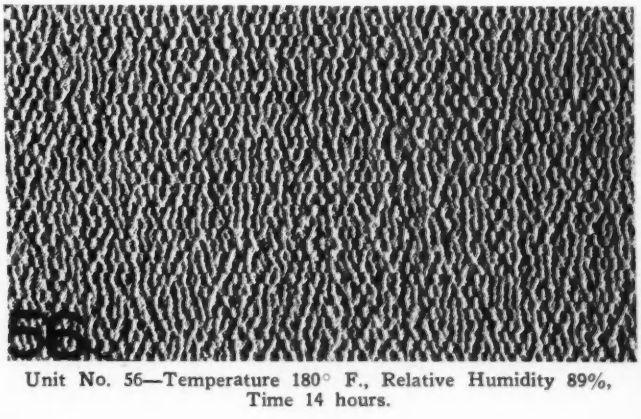
it No. 57—Temperature—205° F., Relative Humidity 92%, Time 3½ hours.



Unit No. 55—Temperature 180° F., Relative Humidity 89%, Time 7 hours.



nit No. 58—Temperature 198° F., Relative Humidity 70%, Time 3½ hours.



Unit No. 56—Temperature 180° F., Relative Humidity 89%, Time 14 hours.

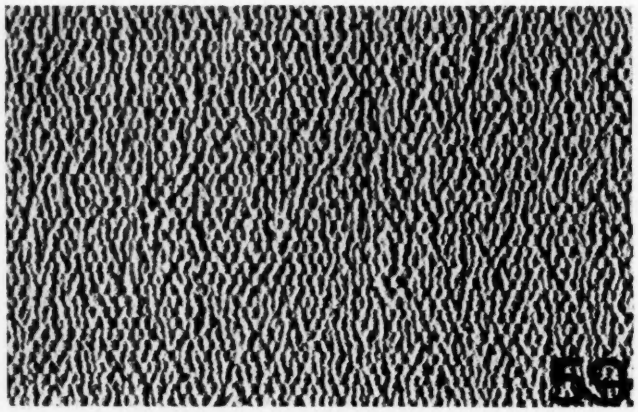
however they did effect the depth of dyeing. The yarn in Unit No. 55 which was steamed at the comparatively low temperature and relative humidity dyed much darker in the same bath. The units which were steamed at higher temperatures dyed correspondingly lighter.

It can be concluded from this investigation that:

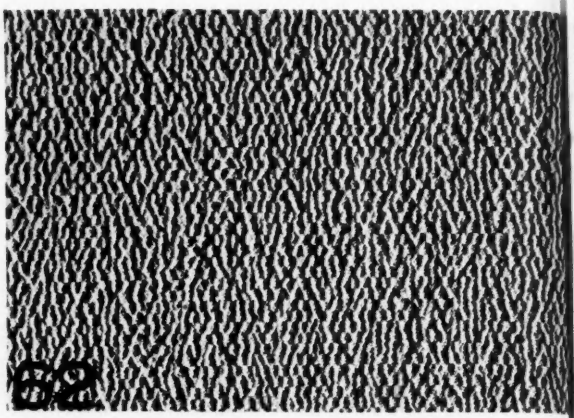
(1) When the temperature and relative humidity in the steaming oven are uniformly maintained variations in time

PLATE K

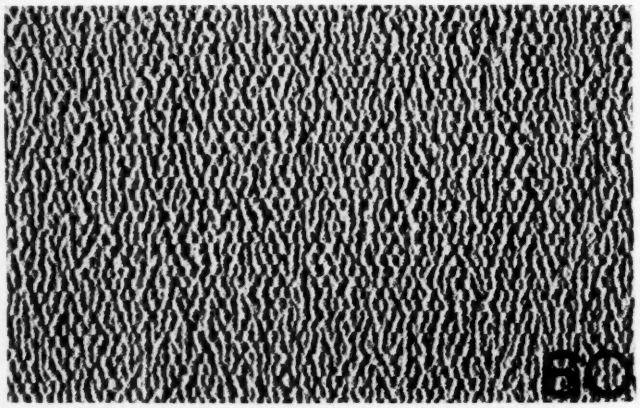
The Effects of Variations in Cop Steaming or Conditioning



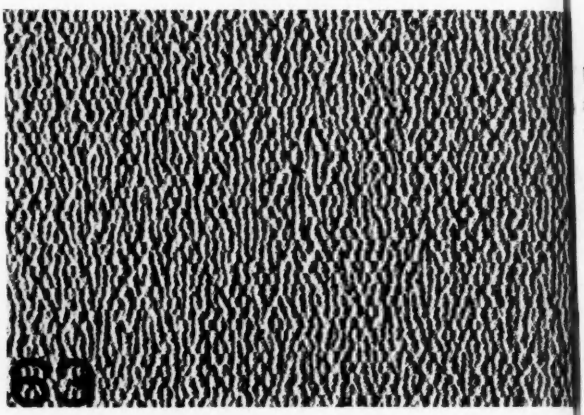
Unit No. 59 (Control)—Not conditioned.



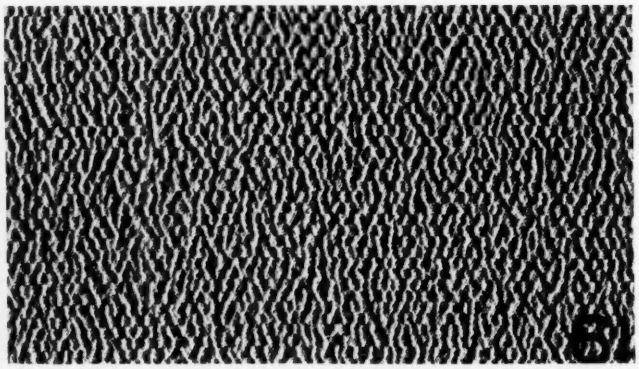
Unit No. 62—Temperature 150° F., Relative Humidity 7
Time 30 minutes.



Unit No. 60—Temperature 150° F., Relative Humidity, 76%,
Time 10 minutes



Unit No. 63—Temperature 180° F., Relative Humidity 8
Time 60 minutes.



Unit No. 61—Temperature 150° F., Relative Humidity 76%,
Time 15 minutes.

of exposure have no effect upon the pebble.

(2) When the relative humidity is uniformly maintained differences in temperature do not materially affect the pebble.

(3) The most important influences in steaming are variations in both temperature and relative humidity.

(4) Differences in dyeing result from variations in temperature in steaming.

(5) Variations in steaming within the tolerances of modern steaming equipment have no effect upon the pebble of the finished fabric.

The photographs in Plate J show the differences obtained by variations in steaming or twist setting.

GROUP K

THE EFFECTS OF VARIATIONS IN COP STEAMING OR CONDITIONING

Heavy rayon crepe yarns frequently become lively and uncontrollable after the copping operation and cause filling loops or small kinks in the woven fabric. The cause of this condition has been traced to numerous sources but often it has remained unknown. It has been possible to overcome the condition however by exposing the yarn in an atmosphere having a high relative humidity or so-called

conditioning the yarn on cops. In this connection special conditioning units or ovens have been built in which is placed several racks of cops at one time. The conditions maintained in the ovens and the length of time the yarn has been allowed to remain in the ovens have depended upon the individual plants.

It was the purpose of this investigation to determine whether cop steaming or conditioning or variations in this operation had any influence upon the pebble of the finished fabric.

Sufficient yarn for this investigation was processed through the throwing and copping operations and was then divided into five units which were individually conditioned in the following atmospheres:

Unit No.	*Temperature*	*Relative Humidity*	*Time of Exposure*
59	Not conditioned	....	.....
60	150° F.	76%	10 min.
61	150	76	15 min.
62	150	76	30 min.
63	180	89	60 min.

The conditioning was done in a Lydon electrical steam box. The racks of cops were placed on a metal frame and absorbent cardboards rested on the tips of the cops to prevent any condensed vapor touching the yarn.

The conditions and times of exposure were intended to approximate commercial ranges but were arbitrarily selected.

Weaving, Dyeing and Finishing

The units were all woven, dyed and finished in the same manner.

Evaluation of the Finished Fabrics in Group K

Cop steaming or conditioning and variations in this process have no appreciable effect upon the pebble of the finished fabric as shown by the photographs in Plate K.

GROUP L
THE EFFECTS OF VARIATIONS IN WARP SIZE

It was the purpose of this investigation to determine the effects of some variations in warp size upon the pebble of finished crepe fabric.

Since an extensive study of this subject is being conducted by the U. S. Institute of Textile Research it was not intended to investigate the values of various sizes. This investigation was confined to a study of the effects of variations in size content upon the pebble of the finished fabric.

Three 40 yard warps were made from the same cones of yarn and then they were sized respectively with soft, medium and hard size. They were identified as follows:

Unit No. 64.....Medium size
Unit No. 65.....Hard size
Unit No. 66.....Soft size

Preparation of the Warps

Warping

The warp yarn was received at the weaving plant on two pound cones. The three warps were made consecutively from the cones on a Sipp-Eastwood horizontal automatic cone creel warper which was operated at 200 yards per minute. Each warp consisted of 19 sections totaling 4740 ends and was 40 yards in length.

Slashing

The warps were sized on a Johnson rayon slasher. The details of this operation were as follows:

Number of drying cylinders..... 5
Cylinder No. 1 was covered while the others were bare
Circumference of drying cylinders. 70 inches
Temperature of drying cylinders.. 1st—150° F.
2nd, 3rd, 4th—170° F.
5th—140° F.
Running speed of warp..... 18 to 20 yds. per min.
Stretch of yarn..... 3.0 per cent

Warp Size Formulae

The warp sizes used contained the following ingredients and proportions:

Unit No.	64	65	66
Water	1600 lbs.	800 lbs.	3200 lbs.
Gelatin	64 lbs.	64 lbs.	64 lbs.
Softener (oil)	15 lbs.	15 ll s.	15 lbs.
Stearic acid.....	1 lb.	1 lb.	1 lb.

The same ingredients were used in each size and they conformed to the following specifications:

Gelatin

Jelly strength—396 Viscosity—127

The viscosity and jelly strength was determined in accordance with the standard methods of the National Association of Glue Manufacturers, Inc. The jelly tests were made at a 7-1 concentration; i.e., on the glue basis. The softener or oil was a mixture of cocoanut and sulfonated olive oils conforming to the following analysis:

Moisture	15%
SO_3	4%
Free fatty acid.....	7–8
Ash	4.5%
Unsaponifiable	Nil

It gave a staple light opalescent emulsion in water.

Preparation of Warp Size

The gelatin was steeped in cold water for four hours, then warmed gradually to 140° F. and stirred until fully dissolved. The stearic acid was melted, mixed with oil and added to the gelatin. The size for each unit was made up to its respective total volume.

Weaving, Dyeing and Finishing

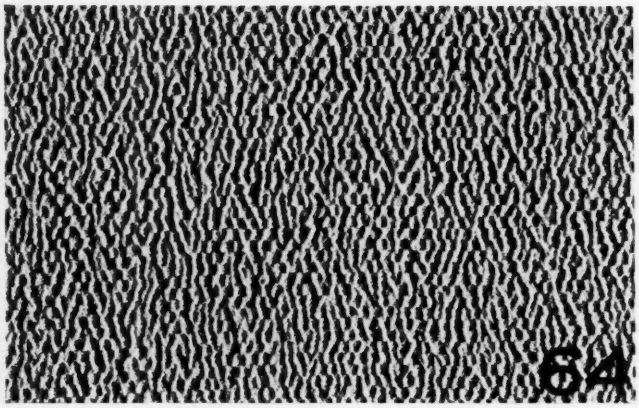
The three warps were woven on the same loom and under the same conditions. The filling yarn was from one unit. The fabric from the three warps was dyed in the same beck at the same time.

Evaluation of the Finished Fabrics in Group L

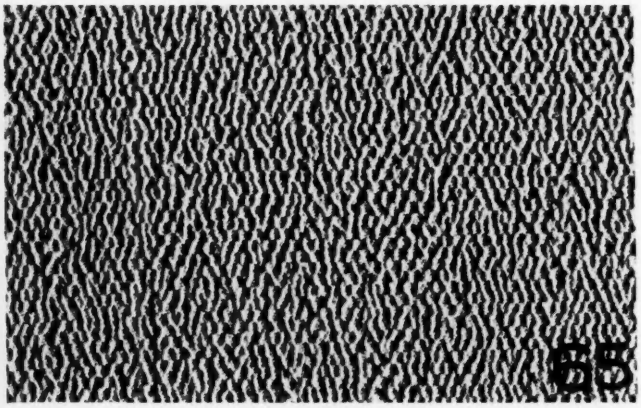
There were some differences in the finished fabric. The fabric with the highest pebble was woven from the warp sized hard. The second highest pebble was obtained from

PLATE L

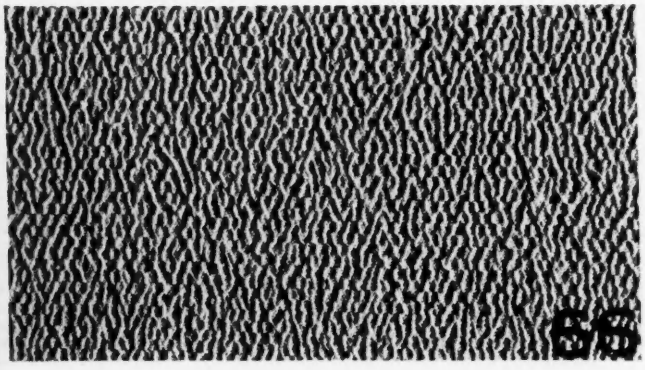
The Effects of Variations in Warp Size



Unit No. 64 (Control)—Medium Size.



Unit No. 65—Hard Size.



Unit No. 66—Soft Size.

the fabric with the medium size and the lowest pebble from the fabric made with the soft warp size. The photographs in Plate L show the differences.

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